The Dock and Harbour Authority

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Editorial Comments

U.S. War-Time Terminal Construction.

The account in this issue by Colonel Jones (U.S. Army Corps of Engineers), of the design and construction of a deep-water "terminal" at an anonymous port in the United States is a useful exposition of constructional methods which have been adopted under war-time conditions to meet restrictions in the use of scarce materials, with additional handicaps due to bad weather and the urgent need for expedition.

The treatment of the problem was naturally in accordance with American principles of construction, as illustrated by many instances of pier installations along the littoral of the United States, where timber is plentiful and conveniently obtainable. In the absence of particulars as to location, we cannot estimate how far these favourable circumstances operated in the case in question, nor indeed, for lack of data, can we discuss the efficacy of the arrangements made to meet the special requirements of the site.

Though the meaning of the word Terminal may, no doubt, easily be conjectured and is, indeed, fully elucidated in the article, yet it has an unfamiliar sound to English ears. It is common enough in the United States and it may be interesting to readers on this side of the Atlantic, to give the precise signification which attaches to it. Quoting from the *Port Dictionary of Technical Terms*, published by the American Association of Port Authorities, the following official definitions are given: (1) The end of a transportation movement, also terminus; (2) A structure or group of structures operated as a single unit, located at a point of interchange between land and water carriers and used for handling and care of passengers and for freight; (3) The freight sheds and passenger stations at a railroad terminus.

Obviously, it is the second definition which applies most nearly in the case of port terminals, and it can be seen that the term includes the whole fabric of the wharf, or jetty, together with the shed superstructure in which the goods are to be temporarily housed (though this is not an essential adjunct), the equipment by which the goods are to be handled and the necessary ancillary rail and road facilities. It is a comprehensive term, and on that ground has claims for widespread adoption even in English port circles, where, as far as we can recall, there is no single equivalent to cover the entire scope and purpose of a quayside installation. "Berth" is sometimes so used, but is scarcely adequately descriptive.

It is true that there is in England the word "terminus," but this is almost exclusively used in connection with a railway line, and, even then, it indicates something of the nature of finality, as if there were no further scope for movement or progress, whereas a terminal signifies a certain degree of continuity, with a change only in means of transport. The word "terminal" also appears in the *New English Dictionary*, but chiefly as an adjective to the substantive station, for which the shorter equivalent is "terminus"; its American usage is ignored.

The foregoing remarks are applicable to a number of terms in general use in port circles, upon which it is undoubtedly desirable to have a consensus of opinion as to their exact meaning, and if possible, to secure the general adoption of an approved nomenclature. These matters have been discussed in committees of the American Association of Port Authorities, but unfortunately, the meetings have not been attended by representatives of English undertakings. It is suggested that there is scope here for a joint conference to clear up the whole situation and so render a service to the profession in general.

Pilotage Problems.

At the Annual Conference of the United Kingdom Pilots' Association which was held in London on the last days of September, at a time when our October issue was at press, a number of proposals were discussed dealing with the present and future position of pilots. Some of these matters had naturally a purely personal basis, viz.: as regards Income Tax adjustments, licences, increase in fees, etc. But there were also matters of a wider range, such as, for instance, the proposal for a central pilotage authority and for the general adoption of compulsory pilotage at all ports. On this latter point a resolution was passed instructing the Executive to take every step in their power to obtain general compulsory pilotage, while as regards the question of the formation of a central authority, this, on the movement of a resolution to that effect, was heavily negatived. It was also decided that a pilot should retain his present status as a licensed pilot and not become the employee of any body, whether local or central.

A further question which arose was whether pilot boats should continue to be privately owned or should be taken over by pilotage authorities and maintained by them. The long discussion on this matter resulted in the adoption of a resolution to the effect that owing to the diversity of conditions at different ports, it was

Editorial Comments—continued

a matter to be decided between the pilots of each port and their local authority.

The foregoing decisions cover three out of the four points to which attention was drawn in the communication from the Ministry of Transport which was circulated before the Conference to various organisations and administrative bodies connected with the Pilotage Services and published in our October issue.

The remaining point, namely, whether the present system of payments to and from benefit funds needed review, evoked a decision in the affirmative, but there does not seem to have been any serious discussion on this matter, nor any indication of special directions in which a revision was desirable. At any rate, the Ministry have now before them a clear expression of the views of the pilots as given at the recent Conference, though it should be stated that the pilots of the Merseyside (Liverpool and Manchester) were not represented there by reason of their preference for affiliation with the Transport and General Workers' Union.

Ships' Tonnage and Port Dues.

In our issue of March 1941, we published an article by Mr. E. W. Blocksidge, lately of Lloyds' Register of Shipping, explanatory of the complicated system by which the carrying capacity of ships is estimated in order to form the basis of their assessment for port dues. Our readers could not fail to be struck by the involved and artificial nature of the calculations, and we are confident that they will feel, as did Mr. Blocksidge, that the method adopted is due for reconsideration and amendment in the light of modern developments.

Such is the conviction, too, which has prompted Mr. A. Murray Stephen, the new President of the Institute of Shipbuilders and Engineers in Scotland, to make it the subject of his Presidential Address, published in this issue. He urges a thorough investigation and overhaul of the existing tonnage laws, which he states "are a disgrace to the shipping community of the world and an insult to their intelligence." He suggests a much simpler standard of calculation, the advantages of which our readers can weigh from his capable and reasoned exposition.

Shipping Lines and Air Transport.

A significant indication of the trend of developments in shipping circles is the recent approval in the Scottish Court of Session of a petition by the Donaldson Line Ltd, of Glasgow, for the authorisation and confirmation of an alteration in the Articles of Association of the Company, by which they are to be given powers to take part in air transportation in connection with their shipping business, so that they can carry on air services, either as additional to, or in substitution for, surface services on the routes at present served by their Line.

Practically simultaneously, at a meeting of Furness, Withy and Co., Ltd., the well-known English shipping firm, a resolution was passed unanimously, which will enable the Company to carry on its business by aerial conveyors, and also to manufacture, prepare, acquire, sell, let on hire and deal in aeroplanes, hydroplanes, seaplanes and aircraft of all kinds.

The above taken in conjunction with a meeting of the General Council of British Shipping held recently in London, when the question of shipping owners participating in post-war civil aviation was discussed, clearly foreshadows revolutionary changes in port affairs. A questionnaire had been circulated inviting ship-owners to express their intentions with regard to air transport. It is stated that the response indicated the existence of an immediate and substantial interest on the part of the ship-owners and the Council made arrangements for those who decided forthwith to take part in air transport to work out their proposals through the appropriate organisations in each category. The Council considered itself charged with the duty of submitting to the Government the proposals which may be formulated.

Port Authorities are, of course, carefully watching the trend of events in order that they may be in a position to meet the changes in the shipping situation as they occur. The years immediately following the termination of hostilities will see radical developments which may, and probably will, involve drastic changes in port accommodation and methods of operation.

Canal and Inland Water Transport Economics.

This Journal has so frequently and so whole-heartedly advocated the development of the canal industry in this country, that it is appropriate to give publicity in its columns (as is done in the present issue) to the thoughtful and stimulating Paper by Mr. W. Fraser on The Economic Future of Canals and Inland Waterways. It would be superfluous to go over the ground which he has covered so effectively in his very knowledgeable survey of the prevailing conditions. He calls attention to the disabilities under which British canals are labouring, and points to the obvious remedies which have been advocated by Royal and other Commissions. Apart from physical defects, which are fairly numerous, perhaps the most difficult problem in canal transport is the diversity of ownership and control. In this connection, Mr. Fraser instances the case of the route from the port of Hull to the city of Birmingham. In a distance of 162 miles, there are no less than nine different sections under the control of six different navigation authorities, whose financial and commercial interests are not always in agreement. As an indication of what may be achieved by amalgamation, there is the example of the Grand Union Canal between London and Birmingham, in which eleven different navigation authorities have been consolidated and unified, resulting in smooth working.

It will be seen that Mr. Fraser endorses the recommendations of the 1921 Chamberlain Committee, and advocates the amalgamation of the waterways into a series of groups to be administered as public trusts. He also urges that if traders are to have vouchsafed to them this system of transport, the Ministry of War Transport must take action before the end of the present period of State Control. There has been so much procrastination in coming to grips with this important issue, that there is ground for fearing it may be once more evaded. This would be a serious disappointment, indeed a calamity, to be avoided if at all possible. We commend Mr. Fraser's observations to the careful attention of those of our readers who are interested in the welfare of the canal industry.

Proposed Harbour of Refuge at St. Ives

In our issue of March 1939, commenting on the tragic occurrence of a night in the preceding January, when seven members of the crew of the St. Ives lifeboat lost their lives during a storm while attempting a rescue from the wreck of the ss. *Wilston*, we drew attention to the particularly exposed nature of the Cornish coast and to the lack of proper harbourage in the vicinity. It is true there is a harbour at St. Ives, but it is quite small and is insufficiently protected. St. Ives has an outstanding position on the northern coast of the county, close to Land's End and is exposed to the full fury of Atlantic gales, the onset of which cannot be predicted with any precision, so that the whole stretch of coast from Hartland Point to Land's End is particularly dangerous to shipping.

There has been frequent, even continuous, agitation locally for the creation of a deep-water harbour at the port, and the project for a substantial breakwater was discussed so far back as our issue of February 1922, when particulars of a design were given which, though officially sponsored, was considered by the Town Council to be inadequate to meet the needs of the case. The matter was brought to the notice of Parliament and the Government of the day indicated their willingness to give it consideration, but apparently no steps have been taken up to the present time.

In the early part of the past month, the provision of a breakwater was again the subject of discussion at a meeting of the St. Ives Town Council, when a resolution was carried to the effect that, as a post-war development, it should be referred to the Reconstruction Committee for consideration. Subsequently, Mr. Alec Beechman, M.P. for the Division, has stated that he has interviewed the engineers of the Royal National Life-Boat Institution, who were in sympathy with the project and had undertaken to prepare plans for a harbour of refuge, capable of affording accommodation to cargo vessels of moderate size. When the plans have been completed, discussed and approved, Mr. Beechman proposes to take the matter up with the Government Departments concerned and endeavour to obtain a financial grant for the scheme.

*The Design and Construction of a Deep Water Terminal**

By Colonel A. B. JONES, Corps of Engineers, U.S. Army.

OVERCOMING the triple handicaps of time, weather and critical materials, an ingenious pier deck design, coupled with channel-dredged material pumped inshore to reclaim underwater land, made possible the recent record time completion, by the United States Engineer Department, of a combined rail and water terminal consisting of a pier, approach trestle and railroad storage yard at a large port.

Knowing in advance that the standard criteria for port development and design would be difficult, if not impossible, to follow, it was decided that within the design study period at the disposal of the department certain essential principles should be adhered to. These were, with respect to site location: proximity to trunk line railroads, accessibility for ocean-going vessels of deepest draft, and an excess channel spoil suitable for land reclamation. Design considerations relative to use were: the degree of desired permanence, provision for future expansion, protection against fire hazard, and conversion to possible future industrial use after the war. Lastly, design necessitated that provision be made for limited use of critical materials and availability of such materials with a minimum of transportation.

Colonel A. B. JONES.

Site Selection

With the need for haste paramount, it was not possible to locate the channel and sequence of dredging operations so as to provide the maximum quality of excavated material for the reclaimed areas. The preliminary borings indicated a combination of undesirable silt formations and suitable sand and gravel strata; but inasmuch as the ultimate plan of development was not completed at the date set for commencement of dredging operations, the location had to be arbitrarily fixed without making full use of the site selection criteria mentioned above. Nevertheless, the Department was fortunate in reclaiming some 70 per cent. of the spoil area. This was more than was required for immediate use, with the balance available for future development at a somewhat higher foundation cost.

*Reproduced from *World Ports*.

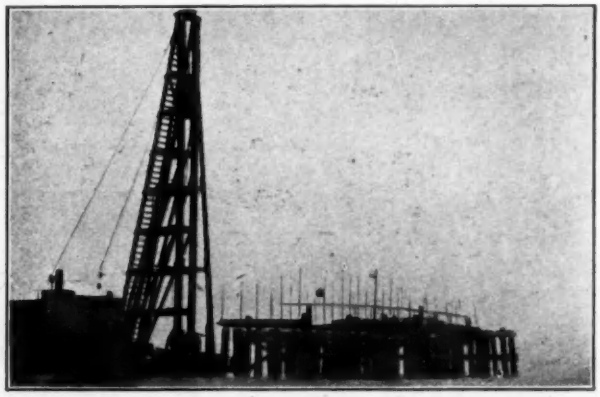
Dredging

Dredging was performed by two suction dredgers, having 27-in. and 26-in. discharge lines. Operating at 3,500 and 4,200 h.p. respectively, these dredgers pumped approximately 30,000 gallons per minute for an average net delivery of 1,150 cu. yds. per hour per dredger. Material was removed from the bottom by a revolving 8-in. diameter cutting head, swinging through an arc and connected to a 29-in. suction pipe on the 3,500 h.p. dredger and a 32-in. suction on the 4,200 h.p. dredger. Spuds placed on either side of the centre at the stern, provided the principal means of local manœuvring over the area.

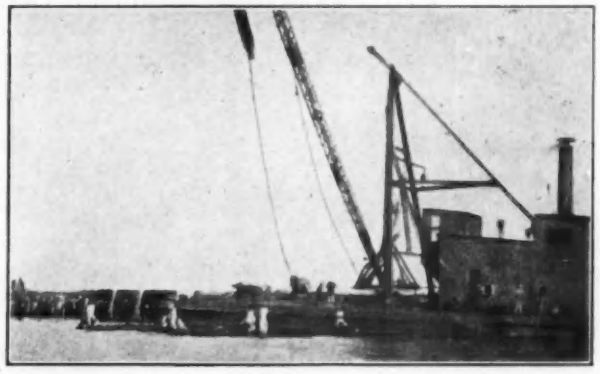
The discharge lines, which at times attained lengths in excess of 11,000-ft., were of welded steel with slip type joints and hydraulically-operated valves. The pipes were supported by pontoons over water and by the previously pumped fill on land. Since a major feature of this project was the close co-ordination of varied construction operations, interference with other floating construction equipment by the dredgers' discharge lines was held to a minimum by the use, where necessary, of submerged pipes connected through a flexible ball and socket joint.

Preliminary to the commencement of production pumping, dykes with side slopes of 1 on 2 and 1 on 30 were constructed by land drag lines and pumping. The dykes were raised to a height suitable for the retention of the pumped material in the spoil areas. Provision for the removal of the supernatant water after settling of the solids consisted of 20-ft. wide timber weirs, the heights of which were adjusted as the level of the settled solids rose. The specifications called for thorough drainage of the spoil areas without leaving pools of stagnant water or obstructions to existing water courses unless adequate diversion channels were provided.

Despite the lack of time for a distribution study, only one soft spot developed, resulting in 4-ft. of settlement within three weeks. The underlying strata at this area consisted of a readily displaced mud which moved outward as the heavier sand and gravel were deposited above. In order to reach the design elevation of approximately +13, it was necessary to carry the fill to +17 at this

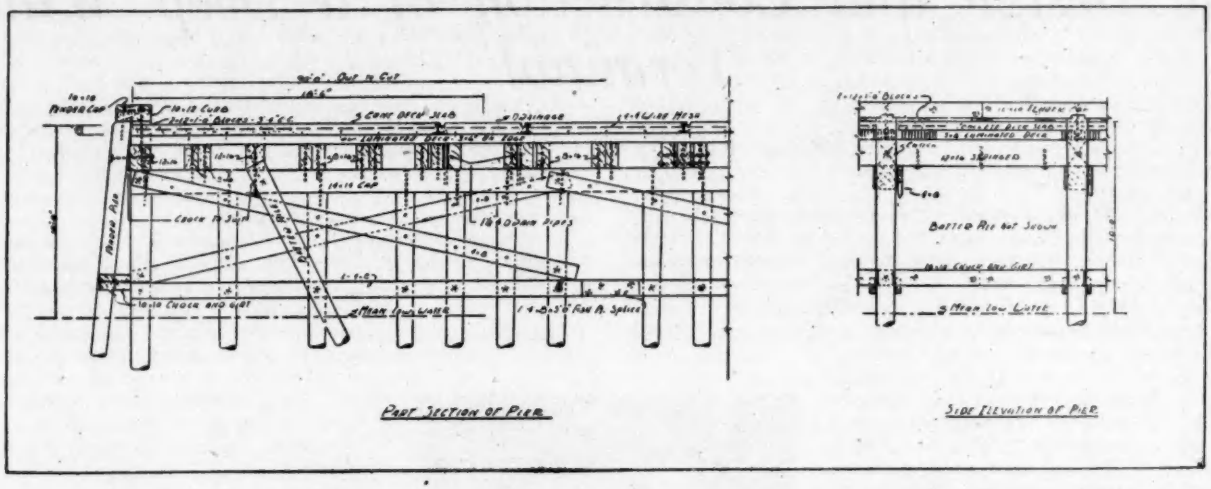


Ranges set on two bents as guide for piles placed by lining.



Batter piles being set and driven by floating derrick. Hammer is slung at proper angle.

Design and Construction of a Deep Water Terminal—continued



point. Some additional settlement may take place which may necessitate adjustment in any non-permanent foundations of structures placed in this soft area.

The river bottom in the pier area was dredged so as to provide a high point along the centre line of the pier, sloping to each side on a 1 on 3 slope to the channel depth. After construction was completed some slight shoaling took place as material sloughed off off the peak. It is possible that the slope selected was a little too steep for the type of material encountered.

Dredging operations were prosecuted on a 7 day, 24 hour basis, employing a crew of 65 to 70 on each suction dredger. A force of 22 was required for the handling of the shore lines. Night illumination was provided by carbide lamps.

Field Location for Dredging and Pile Driving

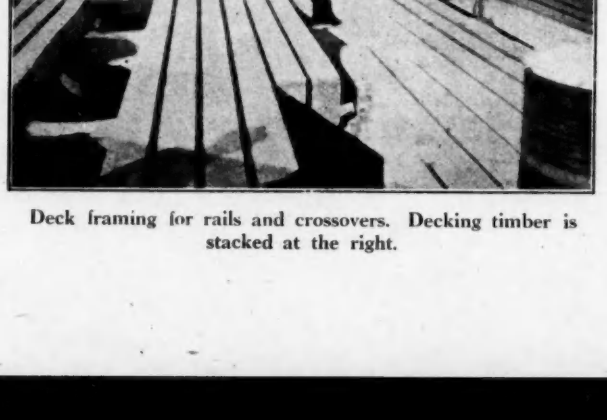
As in any construction over water the problem of field location is quite formidable. It was especially so on this project by reason of the unusual distances from convenient references and was complicated further by a three degree reverse curve in the approach trestle. The difficulties of this work will be realised when one considers the frequent haze over water, the ever-present urgency for speed and the uncertain footing of a small temporary platform in tidal water. Nevertheless, a relatively high degree of accuracy was maintained, for the resulting error of less than one minute is negligible for this type of construction.

Using triangulation to set the critical points, with sight lengths as long as 15,000-ft., temporary pile platforms were constructed at the P.T.'s and P.C.'s of the reverse curve. The ends of the pile bents on the curve were then set by a computed tangent offset to each bent from instruments set on the platforms. All bents on the curve were constructed radially. For pile bents on tangents the conventional method of location was employed, consisting of lining to two rows of ranges set on two instrument-located pile bents 20 to 30-ft. apart. The pile driver captain lines the centre of the leads to these ranges and determines distances between bents by chaining to the bent carrying the near set of ranges. The dredgers were lined by the use of range flags set on land or on adjoining dock structures. All line and grade soundings for record and payment were given by the survey forces of this Department.

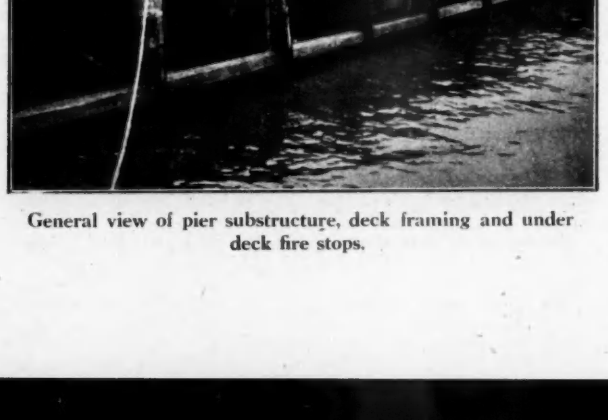
Pier and Trestle Construction

Piling lengths were estimated on the basis of test piles driven approximately every 300-ft. along the centre line of the structure. Piles in the approach trestle area, which had been dredged only to a depth sufficient to accommodate the floating construction equipment varied between 40 and 60-ft. in length. They were placed in 13-pile bents, 41-ft. long and 10-ft. on centres, with a 3 on 1 brace pile at each end of the bent. Piles in the pier area were between 60 and 85-ft. in length driven in 25-pile bents 90-ft. long and 10-ft. on centres. Opposed brace piles pointing toward the centre of the pier were installed on a 2 on 1 batter at each end and on opposite sides of each bent.

The lengths of vertical bearing piles were generally consistent with the test piles and with the slope of the bottom under the pier. At the outer end, however, the test pile lengths were found insufficient and while awaiting delivery of longer piling it was necessary to resort to double lagging with 5-in. by 6-in. timber 20-ft. long. All piles, except fenders, were of untreated Southern yellow pine with a minimum tip of 6-in. and a minimum diameter of 14-in. 2-ft. from the butt. Departure beyond the pile from a straight line drawn between the centre of the butt and the centre of the tip was limited to one per cent. of the length. Piles were driven to a minimum bearing 16 tons as determined by the *Engineering News* Formula, with double acting steam hammers used throughout. An



Deck framing for rails and crossovers. Decking timber is stacked at the right.

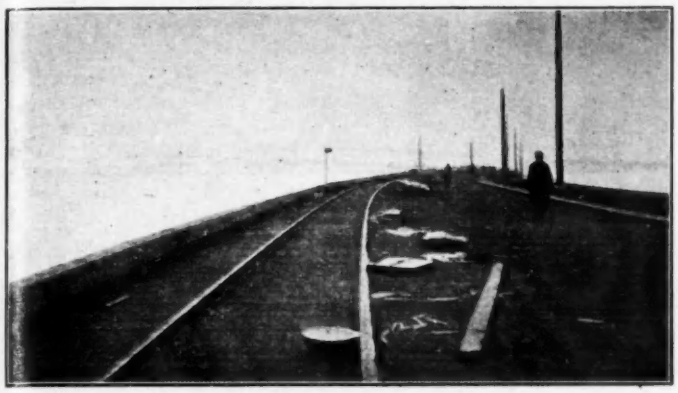


General view of pier substructure, deck framing and under deck fire stops.

Design and Construction of a Deep Water Terminal—continued

average production of 25 to 30 bearing piles was maintained per 8 hour shift, three shifts per day. Fender piles were of oak and were placed on a 10 to 1 batter along the sides of the pier at each bent, using a 3,000 lb. drop hammer.

The brace piles for the pier and approach trestle were handled and driven by floating derricks without leads, equipped with a double-acting steam hammer slung with unequal cable lengths so that the hammer hung at the desired batter. Before setting the pile, its head was trimmed on the catamaran so that it fitted firmly into the pipe sleeve bolted to the steam hammer. The pipe sleeve served the dual purpose of facilitating the placing of the hammer on the previously set pile, and enabling the derrick hoist operator, when the conclusion of driving was neared, to relieve all strain on the hammer so that its fully energy was directed on the pile. In the initial setting of brace piles they were guided in place by longitudinal timber wales fastened to the vertical piles and staggered to obtain the proper batter.



Completed trestle deck with rails in place awaiting concrete wearing surface.

The piles supporting the pump house consisted of jetted 16-in. pre-cast reinforced concrete units driven by a double-acting hammer for the last 3-ft. to refusal.

Piling was paid for at a unit price for each pile rather than by the usual method of a price per foot below cut-off. The contractors' choice of lengths was such, however, that the average cut-off did not exceed 4-ft. The piles were cut to grade by the use of pneumatic chain saws taking compressed air from the floating equipment and from compressors placed on the completed portions of the structure.

Framing

Pile caps consisted of 14-in. by 14-in. timbers fastened to each pile with a $\frac{7}{8}$-in. by 24-in. dock spikes. The use of a concrete wearing surface on the deck eliminated the need for sloping the pile cap to accomplish deck drainage. Horizontal bracing was two 4-in. by 8-in. timbers continuous on each side of the bent bolted with 1-in. bolts to each pile 1-ft. above mean low water. X-bracing consisted of 4-in by 8-in., sloping in opposite directions on each side and at each end of the bents on the pier.

The approach trestle carries two lines of railroad track which branch to four on the pier with numerous turnouts and cross-overs. Directly under each rail there were placed three 8-in. by 16-in. stringers, butt joined and spaced 2-in. apart to allow air circulation. Lap spliced stringers between tracks were 3-ft. on centres for both pier and trestle. The exterior longitudinal line stringer and the pier brace pile cap were 12-in. by 16-in. In setting all stringers care was taken to maintain them at a uniform level in order that the random length decking would bear evenly at all supports. To minimise decay, points of contact between timbers and piles were swabbed with a coat of dead oil of coal tar and all horizontal countersunk holes were filled with hot pitch.

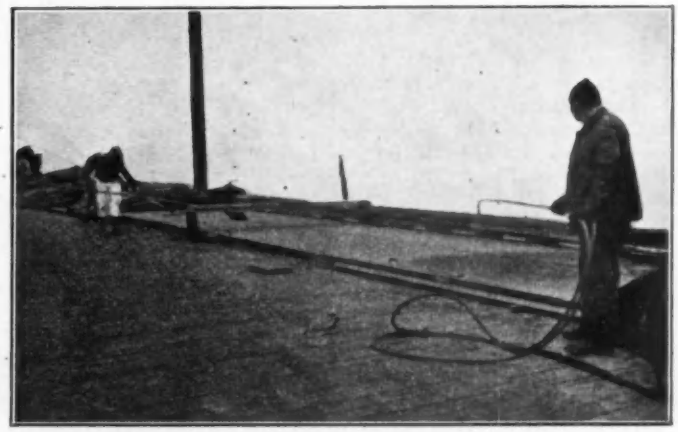
Deck Construction

The deck design had to be such that it would afford the maximum speed of construction with a minimum use of critical materials. Determining that a large quantity of 3-in. by 6-in. yellow pine timber was available at convenient yards and mills, the design adopted placed the 3-in. by 6-in. timbers, pressure treated with creosote oil to a retention of 7 lbs. per cubic foot, toe-nailed on edge to the stringers and solidly nailed to each other to form the main component of the deck. Random 12 to 16-ft. lengths were specified, surfaced one side and one edge in order that a minimum of material might be lost in surfacing and a rough surface for bond with the concrete be obtained. The bond was further strengthened by placing 60d nails spaced 2-ft. on centres in each direction and left protruding 3-in. above the deck timber. Although the locations of the decking butt joints were not considered important, they were staggered so that a plane of longitudinal weakness might not develop.

Six inches of concrete for the wearing surface was then poured directly on this decking and struck off to secure drainage from the centre toward the sides. This type of construction eliminated both the form work and heavy reinforcing steel of standard concrete decks (a light 4-in. by 4-in. mesh was used in this wearing surface) and the problem of winter temperatures and salt spray protection for the under side of the fresh concrete. Driven over the completed timber decking, transit-mix trucks brought the concrete directly to the point of placing. While this method of deck construction was probably more expensive than a solid concrete or timber structure, it had the advantage of time and critical material over the former and fire protection over the latter.

One hundred pound A.S.C.E. rail for the tracks were screw spiked directly to the decking which was previously adzed at the points of contact with the rail base in order to provide a uniform bearing. Between stringers the timber decking carries the full highway deck loading of H20, or a uniform 500 lbs per square foot. The track framing is designed for Cooper's E-60 loading. The concrete wearing surface gives some added strength to the deck in the form of a composite beam, but this value was not used in the design.

Concrete was placed in ambient temperatures as low as 20 degrees Fahrenheit. Prior to mixing, the water and aggregates were heated so that the temperature of the mix, when placed, screeded and broom-finished, did not fall below 50 degrees F. Immediately after the broom application, a bituminous emulsion was pressure-sprayed to a coverage of 1/10th of a gallon per square yard. While the finishing and spraying operations were going on, framing for support of the protective tarpaulins and steamlines were being set. The close co-ordination of activity was such that it was possible to cover the concrete and run steam through the line within 30 minutes after the concrete was deposited. With these precautions and the use of a high-early strength cement in carefully controlled mixes, all test cylinders exceeded 5,000 lbs. per square inch in breaking strength. The deck timber was paid for on a board foot measurement with an extra allowance for the pre-



Finishing concrete wearing surface with screeding and bituminous emulsion prior to running steam and placing tarpaulins.

Design and Construction of a Deep Water Terminal—continued

servative treatment. Concrete was paid for by in-place volume measurement.

Fresh water system used as fire protection. Electric flood lights seen in distance.

Fire Protection

One of the major features of this project was the precautions taken against the spread of the usually disastrous pier fires. First, transverse timber fire stops consisting of 6-in. splined timber, extending from the underside of the deck to 1-ft. below mean low water, were constructed every 300-ft. under the trestle and every 150-ft. under the pier. Flanking each fire stop are two dry sprinkler lines valved to a longitudinal 12-in. to 10-in. header, with runs back to two centrifugal electric pumps supplying salt water pumped from the harbour. The intra-pier electric fire alarm system is designed so that an alarm flashed to the pump house will cause the pumps to be put into immediate operation. Since past catastrophies have frequently been caused by the inaccessibility of an under-deck fire, 12-in. nozzle openings, as a second precaution, were placed at close intervals along both pier and trestle decks to facilitate the use of the now standard angle nozzle for marine fire fighters. Third, an insulated 6-in. wet line which carries potable fresh water for the supply of ships, has numerous valves to enable immediate use of this source for above-deck fires and to supplement the main salt water system.

The electric lighting system provides standard highway luminaires hung on wooden poles along the trestle and several 60-ft. tubular steel towers, surmounted by platforms housing dual batteries of 16-in. louvred flood lights for the pier.

Conclusion

War restrictions naturally prevent publication of information as to the size and location of this project. The features of design discussed above, and the efficiency of the contractor in organising the diverse construction operations and in handling material, enabled the work to set a record for projects of this nature. The design and construction were performed under the direction, supervision and with the collaboration of the United States Engineer Department.

Soviet Trade Union Delegation and Liverpool Dock Workers

Under cover of a communication dated October, 1943, from Mr. R. J. Hodges, (Liverpool Port Emergency Committee) and Mr. S. Mahon (Transport and General Workers' Union), the following letter from the Chairman of the Soviet Trade Union Delegation, which recently visited the port of Liverpool, has been forwarded for publication.

To the Dockers of Liverpool Port.

Dear Comrades,

On September 16th the Soviet Trade Union Delegation had the chance of seeing your port at work. That visit showed us that the Port of Liverpool is playing a great part in the cargo turnover of this country. The hundreds of thousands of tons that pass every month through the Port of Liverpool are of the greatest importance—and not only for supplying the civil population of this country and the armed forces of Great Britain, but also for the other Allied armies fighting at the fronts against our common enemy, Hitlerite Germany and her accomplices.

Part of the cargoes that pass through the Port of Liverpool go to our country too, to the Soviet Union where the most violent battle has been going on with the fascist aggressors for over two years now, and where the freedom and independence not only of the Soviet people, but of the freedom-loving peoples of the whole world are at stake.

In these conditions the smooth and uninterrupted working of your port, and of every one concerned with it, is of exceptional importance. We may say plainly, that in our view your port is one of the most important sectors of the front behind the lines, the front that feeds the armies on active service. And every port worker is a fighter on whose devoted efforts depends to a very great extent the success of our comrades who are meeting the enemy on the battlefield. You dockers are the decisive force in the port. It depends on you that cargoes should be rapidly unloaded and despatched. It depends on you that not a single pound of cargo should remain in the warehouses unnecessarily. A cargo despatched in time means in the long run munitions and arms delivered in time to the front.

We speak with experience when we say that the enemy is cunning and treacherous. He tries all kinds of methods for injuring our struggle in the rear. The German fascist agents try to make use of the least weakening of our vigilance and to take advantage of short-sightedness and backwardness even of individual workers. Enemy agents sometimes try and assume the character of champions of the workers' interests, calling on them to work less and pushing them along the path of strike. But to strike now, in war-time, means to help the enemy. It is only the enemy, only his Fifth Column, who are interested in strikes.

We consider, comrades of the Liverpool docks, that your work is of exceptional importance particularly now, when the enemy on all fronts, and especially on the Soviet-German front, is suffering heavy defeats. Therefore the Delegation of the Soviet Trade Unions felt it necessary to send you this letter and call on you to carry on further industrial efforts, in the name of our common tasks, in order to achieve the speediest possible destruction of our common enemy, and for the sake of establishing friendly co-operation between the peoples of the world after the war.

We delegates of the Soviet Trade Unions appeal to you to fight for the discharging and despatch of all the cargoes passing through the Port of Liverpool as though you were fighting on the battlefield. There ought to be no avoidable delay in unloading ships, not a moment's hold up of ships which leave your port. Let your watchword be the same as that of our workers: "Everything for the Front! Everything for Victory!" This calls for self-sacrifice; but so does the heroic daily battle of our respective armies at the front. We know you have difficulties and obstacles: overcome them resolutely and ruthlessly, for the sacred cause of victory in this war for liberty. Progressive dockers, inspire those backward comrades who don't understand the direct bearing of their work on victory over our common foe! Fight ruthlessly against those who attempt to take advantage of weak morale to interrupt the smooth working of the port, thereby weakening our common effort and helping the enemy.

Long live the dockers of Liverpool Port!

Long live the working class of Britain, and its friendship with the workers of the Soviet Union!

Hasten the victory of the Anglo-Soviet-American coalition!

Death to the German invaders!

Signed on behalf of the Soviet Trade Union Delegation.

Nikolai Shvernik, Chairman.

Ships' Tonnage in Relation to Port Dues

Presidential Address to the Institution of Engineers and Shipbuilders in Scotland

By Mr. A. MURRAY STEPHEN, M.C., B.A.

IN his Presidential Address delivered on October 12th, to the Institution of Engineers and Shipbuilders in Scotland, Mr. A. Murray Stephen, chairman of Messrs Alexander Stephen and Sons, Ltd., discussed the present tonnage laws for ships and the desirability of their revision, particularly in view of their relation to the assessment of port dues.

The address was as follows:

It has been usual for the president at the opening of a new session to give an address on a subpect of which he has a special knowledge. But I feel that on this occasion I ought to devote my attention to a problem which has, for 40 years at least, been discussed from time to time by this Institution and other similar bodies, and which appears to be even further than ever from a satisfactory solution. I refer to rules for the measurement of tonnage of ships. A unique opportunity appears now to be approaching to achieve a revision of these rules. If this chance is missed the probability is that never again will a set of circumstances arise so favourable for a general revision.

After the war by far the largest merchant fleets will be possessed by the United States of America and by the British Commonwealth of Nations. Moreover, of the two great canals used by the ships of all nations, the Panama is controlled by the United States and the Suez by the French and British. In addition, most of the chief maritime nations of the world are working with us in this war. An overwhelming majority of the nations that are most vitally concerned with this problem are, therefore, already linked together in a common cause against Germany and Japan. From the point of view of the shipowner, too, this would appear to be a unique opportunity for a change, if a change is ever to be made. For, almost universally, their fleets are woefully diminished and they are faced with the necessity of rebuilding them over the next few years if they are to maintain their trade. Consequently a change now would have far fewer repercussions than in normal times. But even more important is the psychological attitude abroad among the nations to-day. When everything is in the melting pot men are prepared to examine and consider any change. But when we all slip back again into the smooth stream of peace, men will be less inclined to look with favour on anything which may cause even the slightest ripple of inconvenience on the surface.

The Present Tonnage Laws

The tonnage laws provide for two measurements of tonnage; the gross tonnage—roughly a measurement of the cubic capacity of the ship and her superstructure—and net tonnage, which is supposed to represent the cubic capacity of the spaces in the ship which earn money. For the purposes of assessing the ship for dues the net tonnage is usually used, though for some purposes such as dry dock dues, the gross tonnage is sometimes applied. It would therefore appear that, in general, the port dues are assessed on what was supposed to be a measure of the earning capacity of the ship. But is this the right principle to apply? In the rendering of most other services the payments are not based on this principle, but are based roughly on the cost to the supplier of rendering that particular service. So there are strong grounds for challenging the very principle upon which the present tonnage laws are based.

I will not attempt even to sketch the evolution of the tonnage laws, as this has been dealt with many times before. Suffice it to say that, while the early laws were framed in an endeavour to provide a fair basis for taxation as between ship and ship, these early laws have been so amended and overlaid with compromise that in the discussions on the subject no one has ventured to defend them on the ground that they are fair. But apart from their fairness or otherwise, they are now very complicated and require the measurement of most spaces in the ship. It would be interesting to know how many surveyors all over the world spend the greater part of their lives measuring ships for tonnage, an occupation in which there might be some satisfaction if it were the only way to achieve fairness, but of which under the present rules this cannot be said. If a simpler and fairer set of laws can be found—and I am sure that it can—then those highly skilled men are simply wasting their energies on the altar of an outworn conservatism, and not only their energies but the shipowners' and the nation's money.

Because the present tonnage laws are unfair as between ship and ship, shipowners and builders are forced to produce ships which are in many respects neither as efficient nor as seaworthy as they might be. Consequently, if a ship does not take advantage of some of the loopholes in the law she is penalised and has to pay higher dues all her life. The most important of these so-called loopholes, and the one most likely to have important effects on the future, is the way in which machinery spaces affect tonnage. If the machinery spaces of a ship, including light and air trunks, and shaft tunnels, amount to 13 per cent, or more, and under 20 per cent., of the gross tonnage of the ship, then a 32 per cent. deduction is obtained from the gross tonnage in arriving at the net tonnage. Now, modern machinery is becoming lighter and lighter, and more and more compact, and we have already reached the stage where the designer has often, in order to get up to the 13 per cent., to provide large spaces in the centre of the ship which are simply wasted. He has even sometimes to build up his engine or boiler hatch above the boat deck, sticking up into the air, in order to increase the entire space which comes into machinery space measurement.

Hidden Empty Spaces.

As machinery becomes smaller and still more compact, as it undoubtedly will, many a ship will carry round with her all her life a large, useless, almost empty space in her middle. But it is hidden and no one sees it, and those who sail in ships have become so used to it that they never think about it. If these hidden empty spaces had been visible, like a funnel or a mast, public opinion would, before now, have forced a revision of the rules. A distinct brake is thereby put on the progress of marine engineering in that a part of the benefits which smaller and lighter machinery should reap is withheld. Admittedly some limiting factor was necessary in the past, and may be necessary in the future, to ensure that working spaces, such as engine and boiler rooms, are ample for the health and well-being of the men who work in them, but surely this is a function which the Board of Trade should exercise quite apart from tonnage measurement.

Another entirely illogical situation has been created by the effect of the measurement of superstructures for tonnage. Originally, no doubt with the laudable idea of encouraging as much enclosed deck shelter as possible, superstructures which were not totally enclosed were exempted from all tonnage measurement. But as time went on, the superstructures became larger and the apertures to them smaller until the position became quite topsy turvy; it now amounts to this, that if one has a complete superstructure one may, by making apertures in it, and by fitting scuppers to it, thereby making the ship less seaworthy, render it exempt from net tonnage. It is true that these apertures may be boarded up, but the regulations strictly forbid any sort of door or permanent form of fastening, if the exemption from net tonnage is to be retained. The details of the application of this regulation, as to when such a superstructure may or may not be exempt, reach such a fine point

Ships' Tonnage in Relation to Port Dues—continued

of delineation as to be ridiculous. In the case of a river steamer, I am told that the decision for or against the inclusion of a deck shelter in tonnage almost turned on whetner curtains and aspidistras were supplied or not, and I can well believe it.

The commonest type of ship affected in this way is that known as the shelter deck ship. In this type the shelter deck superstructure covers the whole deck of the ship and the shelter deck has in effect become the weather deck of the ship. But, if a tonnage opening is left in the deck just large enough to fulfil the definition of such an opening, the whole of this shelter deck space is exempt from net tonnage except such space as happens to be occupied by cargo. The tonnage laws have here offered a very heavy bribe to owners and designers and a large number of shelter deck ships have been built. So far has this idea been developed that in some recent coasters the shelter deck space looks as though it actually were more than the remainder of the cargo space. During the war these shelter deck ships have their tonnage openings closed by means of a permanent and sound type of structure and have been enabled to take advantage of increased draught in consequence.

It is possible that owners of shelter deck ships would be averse to any change in the tonnage laws which had given them these advantages, and that there are so many of these owners that they would be able to defeat any change. But is this not a short-sighted view? Provided that a fair solution were found as between ship and ship, the shelter deck type would suffer no injustice, while all shipowners would benefit by being able to get better designed ships at less cost owing to the elimination of useless and often harmful arrangements necessary to circumvent the tonnage laws, not to mention the fees for making the present elaborate measurements, which would become largely unnecessary.

Double Bottoms

There are many other ways in which the tonnage laws react unfairly between ship and ship, although perhaps not quite so striking or so ridiculous as these two. One concerns the measurement, or rather exemption from measurement, of double bottoms; others concern the way in which measurement is taken to face of the frames of a ship and to the way in which sparring and ceiling are treated. In tankers, for instance, the framing is often made deeper than it need be simply to avoid the effects of tonnage measurement.

These are, in brief, some of the reasons which show why the present tonnage laws are unfair as between ship and ship, even if they were administered and interpreted on the same uniform basis. But tonnage laws must inevitably be administered by a number of different authorities of different nationalities all over the world, and the more complicated they are, and the more definitions which lend themselves to differences in interpretation, the greater becomes the scope for further unfairness. The nation which applies a strict interpretation may well be handicapping its ships as compared with those of a nation where the interpretation is lax. If, however, some simple and easily checked tonnage laws were in operation this inequality of treatment at least would be avoided.

The problem of finding a single and fair tonnage law is very similar to the problem which has faced those who have framed the rules by which racing yachts have been measured. In the case of racing yachts, the old tonnage rules were at first used, but as designers found ways of cheating the rules, new rules had to be produced. At one time, length between perpendiculars was one of the main ingredients of a formula, which was killed by the famous *Jullanar* in 1874, where the sternpost was placed very far forward. But the main object of all yacht rules is to provide a rule which, while giving a designer as much latitude as possible, tends to penalise all yachts which do not approach to the type which has been proved by experience to be the most suitable for the purpose. The problem for ships is easier than that for racing yachts, because there are considerations other than speed which tend to keep ships to the most suitable type. In fact, most ships would certainly have been better designed, and more efficient, if the tonnage laws had not existed when they were built.

It would, perhaps, be possible to amend the existing laws so as to remove the handicaps to design which they now present, but with each ammendment the laws and their interpretation would almost inevitably become more and more complicated. But why preserve an unnecessary and laborious process for achieving a comparatively simple end? The main object of tonnage laws is to provide a yardstick by which to assess the dues which each ship shall pay for the use of ports and canals, and surely the simpler the law is, and the more easily checked it is, the better.

Length, Breadth and Draught

Some of those who have studied the matter have advocated displacement as the best yardstick on the grounds that displacement has already had to be measured for load line assignment. There is logic in this solution, but it is open to the argument that it would unfairly affect the ship with the full coefficient as compared with the ship with the fine coefficient. Moreover, it is not an easy matter to check the displacement of a foreign ship coming into your ports. Would not the fairest and simplest tonnage law be a formula composed of the three main dimensions which measure roughly the cost of building and maintaining the harbour or canal facilities—length, breadth, and draught of water? A formula based on these three is entirely logical for its main purpose—the assessment for dues; and, moreover, these three dimensions are so easily measured that there should be no room for differences in interpretation in different parts of the world.

The only difficulty—and not a very great one at that—in making up such a formula is the definition of length, breadth and draught. If we defined length as the over-all length, the tendency would be for ships to have vertical stems and sterns which, apart from being unsightly, are not the most serviceable forms. If we define length as length between perpendiculars, the tendency would be for sternposts to be placed further forward than would be desirable. If we define length as length on the water-line at full load draught, the tendency would be for excessive overhangs above water.

It would be appear, therefore, that whatever definition of length is adopted must be qualified in some way. A definition such as this might meet the case—"Length shall be the length on load water line, provided that the overall length shall not exceed the L.W.L. length by more than 2 per cent. at the fore end, and 3 per cent. at the stern. If the overall length exceeds the L.W.L. by more than these amounts, each excess shall be added to the length for tonnage purposes." Or, alternatively, length might be defined as "length between perpendiculars with an allowance of say 2 per cent. forward and 4 per cent. aft." This would bring us close to the definition used by the classification societies, which is roughly the length, on the water line, from the stem to the sternpost, with allowance of 4 per cent. This definition would probably need to be qualified by allowance of say 2 per cent. at the fore end, and the allowance of the after end should not be confined to water line length, but made to cover overall length.

Breadth presents less difficulty. The extreme beam, as presently measured by the Board of Trade, would give a fair measurement. The only qualification needed would be to allow the overhang of one or more unenclosed decks by say 2 per cent. of the beam on each side, to meet the case of passenger vessels, or of docking platforms over-hanging from the navigating bridge. Draught would be defined as the salt water draught to the summer load water line.

Suggested Formula

It is suggested that a formula L x B x d/a coefficient = Tonnage, would give a simple, fair, and easily measured tonnage for all ships, and would have the minimum hampering effect on design. Another alternative would be to use depth in place of draught. Some naval architects already use a formula Length x Breadth x Depth x a coefficient to estimate approximately the tonnage.

Admittedly, any change in the tonnage laws would involve a large amount of office work and issue of new tonnage documents for existing ships as well as an adjustment of the scales of charges to all ports and canals; but as a change in the present complicated and certainly unsatisfactory law is more than overdue, surely this opportunity should be taken to put the tonnage law on a simple basis. There is no need whatever to have two tonnages such as gross and net, and while we can never get rid of displace-

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(continued)

ment tonnage and deadweight tonnage, it is suggested that if there is one universal tonnage on which the dues were paid in all ports and canals, this and this only would tend to be used for all statistics. So far as harbour and canal authorities are concerned, their main concern is the amount of revenue which they collect in dues. If therefore a change in tonnage laws alters the total amount of tonnage using the port or canal compared with the present position, the collecting authority has merely to apply a factor to its existing scale of charges. This factor would be easily found by taking an average selection of the ships concerned and comparing their tonnages under the old and the new conditions.

The minds of the laymen, the public and the politician are continually being confused by the production of figures and statistics making use sometimes of one tonnage measurement, sometimes of another. No layman can easily understand the difference between gross and net tonnages. One simple universal tonnage law would make all shipping questions very much easier to understand and to handle. For the good of shipping as a whole, it seems obvious that the question must be tackled, and tackled in a radical way—tinkering with it will only waste time and energy for years to come and will perpetuate an anachronism, a fetish, to the services of which many good surveyors all over the world have given their life's work quite unnecessarily.

When I come to review the whole position, I think that I am entitled to put it even more strongly and to say that the present tonnage laws are a disgrace to the shipping community of the world and an insult to their intelligence. Their net result is:

(1) To waste the life work of a large number of skilled surveyors and much time in shipyard drawing offices, where men have to learn the refinements of the tonnage laws and to become experts in the art of circumventing them by legitimate expedients.

(2) To produce several forms of tonnage figures confusing to the layman, and even to those in the industry;

(3) To encourage owners to make openings in some types of ship, thereby making them less seaworthy;

(4) To force designers to make machinery spaces much larger than they should be, leaving large empty spaces in the middle of the ship and discouraging new types of machinery;

(5) To give considerable latitude to their interpretation, allowing the lax to score over the strict;

(6) To make the tonnage of a loaded ship almost impossible to check, and, finally,

(7) To give anything but a fair assessment between ship and ship.

These seven evils, inherent in the present law, make it imperative that a clean sweep should be made, and a completely new and simple law evolved. No tinkering with the old law can be satisfactory. Any new, simple, well-thought-out and fair law would be of enormous advantage to the shipowners, the shipbuilders, and the engineers. And now is the time for it.

The root of the whole trouble has been the principle on which the old tonnage laws were based, and that is to say, the earning capacity of the ship. If the alternative principle, which is obviously the right and equitable principle to use, namely, the cost of the service rendered to the ship, had been employed, the tonnage laws would not have got into anything like the muddle in which they are to-day. Even if they were to be revised now, if they were to continue to be based on the wrong principle, they would almost certainly get into a muddle again. I cannot too strongly emphasise that, in my view, it is this fundamental mistake of principle which has caused all the trouble and which will continue to cause trouble until it is altered.

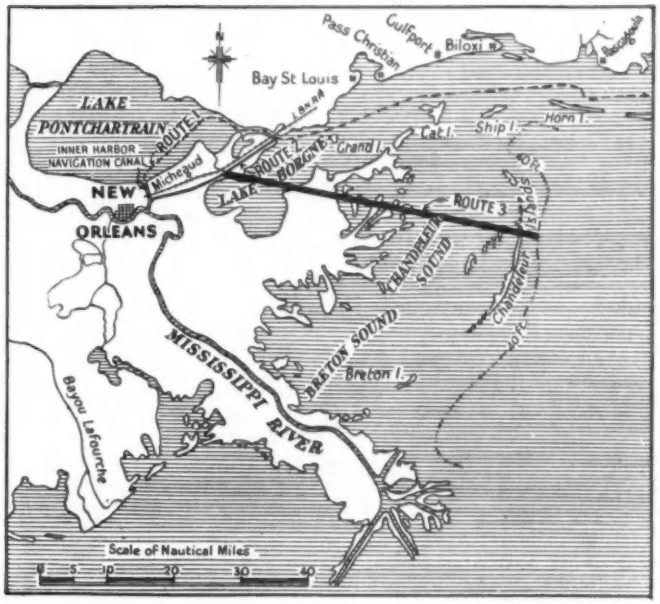
New Steel Lifeboat for Tankers.

Arrangements have been completed for the mass production of a new type of steel lifeboat for use on tankers, and initial orders for 500 such boats have been placed by the Ministry of War Transport. The lifeboat embodies a number of new features designed to afford maximum safety and in particular to mitigate the hazard of fire. Another feature is the increased provision for the comfort of occupants.

The Alexander Seaway

Proposed New Channel Entrance to Port of New Orleans

A Public Hearing was held at New Orleans on August 5th, by Brig. Gen. Max C. Tyler, President of the Mississippi River Commission and Division Engineer of the Gulf Division of the U.S. Army Corps of Engineers, to consider the proposal for the creation of a new 40-ft. tide-water channel from the New Orleans Industrial Canal to the Gulf of Mexico. The scheme is being sponsored by Col. Lester F. Alexander, former Chairman of the Board of Commissioners of the Port of New Orleans and still a member of that body, which supports the movement. A description of the project by Col. Alexander in a recent address to the New Orleans Association of Commerce was published in the issue of this Journal for July last.



Evidence in favour of the creation of the new tide-water channel was given by representatives of a number of local interests and by public officials. The following points were put forward by Col. Alexander on behalf of the project. (Route 3 in map above).

1. It would provide a deep, safe and dependable tidewater channel of about 68 or 70 miles from New Orleans to deep water in the Gulf.
2. Its construction presents no difficult problems in engineering.
3. Its cost is reasonable in comparison to the benefits to be derived now and in the future.
4. It would provide a safe navigable channel every day in the year.
5. It would not be subject to shoals occasioned by precipitation of material carried and sand waves.
6. It would not present the difficulties of sharp bends, fogs, strong currents or the hazards at the jetty ends.
7. It would be susceptible to deepening and widening, if, as and when desired or needed.
8. It would make available large areas of reclaimed land for use in the future development now being given consideration.

Death of Harbour Bridge Engineer.

The death is announced, at the age of 76, of Mr. John Job Crew Bradfield, C.M.G., D.Sc., M.E., M.Inst.C.E., the Australian engineer who constructed the celebrated Sydney Harbour Bridge to the designs of Mr. Ralph Freeman, M.Inst.C.E., partner in Freeman, Fox and Partners, MM.Inst.C.E., London. Mr. Bradfield died in Sydney at the end of September.

Notes of the Month

Harbour Appointment at Avonmouth.

Following the death of Captain E. M. Sincock, reported in last month's issue, Captain W. Nicol Cook has been appointed Harbour Master at Avonmouth Docks, Port of Bristol. After a long period at sea, Captain Cook entered the service of the Port of Bristol Authority, first at the City Docks and subsequently at Avonmouth in 1929, when he was appointed Assistant Dock Master. In 1936, he became Deputy Dock Master, a position which he has held until the present time.

Increase in Australian Dry Dock Accommodation.

The Australian Minister for the Navy, Mr. Makin, recently declared in Melbourne that " as soon as man-power and materials are available, steps will be taken by the Federal Government to ensure increased dry dock facilities at a port in Victoria. These difficulties will not prevent the Government from making preparatory arrangements for improvements of docking facilities. Australia's defence plans will not be complete until there are dry docks in each State."

New Dockers' Canteen at Southampton.

A new Canteen at the Southern Railway, Southampton Docks, was opened at the beginning of October, by Mr. R. Chick, the area secretary of the Transport and General Workers' Union, who was accompanied by General Phillips of the U.S.A. Port of Embarkation Transportation Corps; by Mr. H. A. Short, Southern Railway Docks and Marine Engineer and Chairman of the Port Emergency Committee, and by a number of other officials and Ministerial Representatives. General Phillips spoke a few words in praise of the work done by the Southampton dockers.

War Damage to Docks.

Representations have been made by British Dock Authorities to the Treasury and to the Ministry of War Transport regarding the 50% proportion of war damage costs which they are expected to pay. It is felt that harbours and docks had been singled out for attack by the enemy and that the undertakings were, therefore, in a worse position than other public utilities in regard to such contributions. The suggestion has been put forward that the Government should introduce a Bill to deal with the inequitable situation.

Appointment of Regional Port Director.

The Minister of War Transport, has appointed Sir George Campbell, K.C.I.E., to be Regional Port Director for the South-East of England, including the Port of London. Though Regional Port Directors have been appointed for Scotland, the North-West of England (Mersey), the Bristol Channel, North-East England (Tyne and Tees) and the Humber, the Regional Port Organisation of the Ministry of War Transport has not hitherto extended to the South-east of England. Sir George Campbell was formerly Shipping Controller and also the Representative of the Ministry of Shipping (afterwards Ministry of War Transport) in India. Since his return from India in 1942, he has been working in the Ministry at Headquarters.

National Dock Labour Corporation Appointments.

The following appointments at ports in Great Britain have been made by the National Dock Labour Corporation:—

Mr. F. P. Hogger, formerly Assistant Manager for the Port of London, has been appointed London Manager, and Mr. J. H. Saunders becomes Assistant Manager. Mr. Saunders was previously Manager of the Middlesbrough and Hartlepools Board, and earlier he had been Manager of the Swansea Board.

Mr. H. J. Steele, the new Manager for Middlesbrough and Hartlepools, was previously with the Ministry of War Transport at Salford.

Mr. F. J. Norris has been appointed Manager of the Hull and Goole Board; formerly he had been Chief Clerk on the London Headquarters staff.

Mr. W. E. Smith has been appointed Manager of the Cumberland ports.

Proposed Air Base at Southampton.

The Southampton Harbour Board have had under consideration a scheme for the establishment, after the war, of a combined land and sea air base at the Port of Southampton. A joint report on the matter has been drawn up by the Clerk, Mr. O. H. Lewis, the Harbour Master, Mr. F. W. Frampton, and the Engineer, Mr. J. P. M. Pannell. This report has been submitted to the Works and Harbour Committee, who have referred it to a special Sub-Committee consisting of Alderman Sir Sidney Kimber, Chairman of the Committee, Mr. Harry Parsons, Chairman of the Board, Commander J. Bird, Mr. C. E. Cotterell, and Mr. M. G. J. McHaffie, M.Inst.C.E., Docks Engineer, Southern Railway, for consideration and report.

Dry Dock Company's Report.

Profit of the Prince of Wales Dry Dock Co., Swansea, Ltd., for the year ended April 30 last amounted to £23,856 after providing for taxation (compared with £21,146 for 1941-42). Out of this sum the directors have transferred £6,853 (nil) to general reserve account, £5,000 (£3,500) to central depreciation reserve and £3,500 (£5,000) to reserve for contingencies, leaving £8,503 (£12,646). To this was added the balance brought forward of £15,862 (£14,466), making £24,365 (£27,112). Last year's figures are given within brackets. Deducting the interim dividend of 7½ per cent. and bonus of 2½ per cent., both less tax, paid in May, the amount left to be carried forward is £16,865.

Fire Service Help in Dock Emergencies.

Two instances have recently been given in the press of valuable assistance rendered by the Merseyside Fire Service in emergency operations in dock work. In one case, it became imperative for an electric wiring system to be changed and this involved putting the pumping machinery of a dry dock out of action for a whole day. Two ships were under repair at the time, and there seems to have been considerable leakage through the dock gates, estimated at a thousand gallons per minute. With the assistance of the Fire Service, four trailer pumps were lowered on to the dock floor and a 6-in. fire service pipe-line, a quarter of a mile in length, was laid to convey the discharge into the river. In the second case, a National Fire Service crew, for 20 days and nights, stood by a damaged ship in which water had seeped into a deep tank containing magnesium, with the result that an explosive gas was being given off and the bulkheads were heating. The firemen worked in relays spraying water on the bulkhead till the danger was removed.

Ship Canal Proposal in Central England.

In a lecture to the Manchester Geographical Society, Mr. Ellis Smith, M.P., urged the construction of a ship canal to link up the Manchester Ship Canal with the Humber.

"A canal cut across England through the heart of its main industrial belt would," he said, "help to make Britain greater than ever before, and would enable us to maintain in peace-time that dynamic democracy that has been created during the war." It would cut food transport costs, provide for the efficient and speedy handling of goods, and help to give Britain a greater share of world trade through quick access to the ocean routes. Running through an immensely important industrial part of the country, it would re-open and revive what were once distressed areas, stimulate industries, and create new inland ports. The difficulties of construction of such an Atlantic-North Sea canal would, with present mechanical devices, be nothing compared with those confronting the builders of the Manchester Ship Canal towards the end of the last century. "Some people might say that a canal linking the Forth with the Clyde would be a better proposition than one joining the Mersey with the Humber, but the probability is that we shall need both," said Mr. Smith. There were vast possibilities in providing waterway "arms" to bring towns like Preston, Skipton and Leeds into the scheme. If the canal ran from Manchester through Penistone, Pontefract or Doncaster on to Goole and Hull, it might provide a solution to the serious river flooding problem in the Don Valley.

Quayside Cranes and other Cargo Handling Appliances at Ports

By J. DALZIEL, M.I.E.E.

(Concluded from page 131)

Braking and Control

Braking and control are almost invariably interconnected and to a large extent operated by the same apparatus and therefore closely affect each other.

Dealing first with braking so far as it can be separately dealt with, steam crane brakes are, in all ordinary cases, foot or hand brakes directly operated and acting on the winding barrel after it has been declutched. Brakes for other motions are provided only sometimes. It is necessary in exposed conditions to guard against movement by wind.

Hydraulic cranes provide their own brakes, inasmuch as if the valves are closed motion cannot take place.

With electric cranes, braking methods present themselves in variety. The simplest form of brake for an electric crane is what is known as the solenoid-operated brake, in which the brake is applied by a weight or spring, generally the former, applied through suitable lever or other purchase mechanism, the braking effect of which is relieved by the action of the solenoid, through which the motor current passes when the movement is switched on, and which applies itself automatically when current is switched off. This, in itself, is not a satisfactory braking method, failing the provision of means actuated by foot or hand lever by which the brake can be eased off manually to allow of the load lowering at a suitable speed under control.

This applies of course more especially to the brakes on the lifting and lowering movement.

This form of brake is sufficiently satisfactory to be all that is provided in many cranes, particularly three-phase cranes, but it will be obvious that the amount of brake power is set definitely by the actuating weight, or the power of the springs, and the crane driver is powerless to increase it should he wish or require to do so under emergency conditions.

The point where brakes should be fitted is affected by the fact that the higher the shaft speed, the less the weight and solenoid power required for equal braking effect. On the other hand, the ideally safe position is for the brake to act direct on the main winding drum, where it can still be effective should gear teeth break or other similar accident take place.

On the other hand, especially in the most modern cranes, brake power is largely electric, exercised by action within the motor and that being so, the main braking effect must act through the motor shaft and the whole of the gearing.

For quayside cranes, the writer considers it desirable to have on the main drum shaft one brake, at least, which may be an emergency one, but the actuation of which should be amply easy for the crane driver.

Free Barrel Braking

For D.C. cranes, the writer has largely used free barrel braking, which is well suited to high speed work, and at the same time is simple and probably less expensive than any other type save the plain solenoid with mechanical release. It is, however, less used in modern cranes than some of the other forms of braking about to be described, partly, it is understood, on the basis of its making a greater demand on the skill and intelligence of the crane driver than in the case of some of the other brakes.

As regards this point, the writer is bound to say that his experience is that, with the very simplest form of free barrel braking making a demand on the driver's skill with every lift on a fairly busy installation of quayside jibs, no accident took place in the course of over 30 years.

The free barrel brake originally followed fairly closely the lines of the steam crane brake, being a direct-acting brake applied after declutching with its effect adjustable at the will of the crane driver and, therefore, giving him the sense of power of control essential to high speed lowering. It lends itself also to high speed in other directions; with it, only the winding drum rotates in lowering, so that there is no loss of time in overcoming the inertia of the high speed armature, not only in re-starting it but in stopping and reversing, because with this type of brake the drum is released from the armature to lower and the load can be half way down before the latter has stopped.

The arrangement in general is that the winding drum is coupled to the shaft through a friction clutch, which is generally of the coil clutch type. The brake acts on the brake drum coupled to the winding drum; brake or clutch, or both, could be on a higher speed shaft and would then be lighter and cheaper, but, as already expressed, the writer's preference, and general practice, is for the brake to be on the drum shaft itself.

A solenoid brake may, however, be fitted to, say, the motor shaft and the crane be worked as solid coupled if desired for special lifts.

In working "free barrel," on switching off at the top of a lift, during which the crane may have been slewed and luffed and be ready for lowering, the winding drum is disengaged from the motor by release of the clutch and lowered in charge of the brake at such speed as the driver thinks fit, and knows he can control. The clutch may be hand or foot operated, but, in general now-a-days, is worked by solenoid. In early forms the clutch was engaged by a series wound solenoid as current was switched on to hoist and therefore automatically disengaged the winding drum at the top of the lift as current was switched off. The crane driver had, therefore, to be ready to take charge of the load on his foot brake as he brought his controller to neutral— and in the event of any failure of current as well—but, as already instanced, in no case over a period of many years was there failure to do so on an installation of busy cranes with which the writer was associated. On later cranes, the coil clutch was mechanically released and applied by hand lever, and still later the clutch was disengaged by shunt solenoid excited on the first lowering notch of the controller.

This latter is a very satisfactory and labour saving device, but it has the disadvantage that in the event of any failure of current e.g. by the opening of a circuit breaker, the clutch will be re-engaged and the moving load thrown suddenly on to the stationary gear and armature with resultant shock and possible damage. It is necessary, therefore, to provide an interlock in the form of a stop preventing the clutch solenoid, after it has risen for declutching, falling back again to reclutch while the controller is in the lowering position, or otherwise than by deliberate act of the driver. The "stop" must, of course, be actuated direct from the controller, and not by the movement of the solenoid itself.

Very fast working can be attained with free barrel cranes but they undoubtedly call for skill and quick wittedness on the part of the operating staff. In the writer's experience men, who are trusted generally justify the trust put on them, but where apparatus has been devised and is available making less demand for operative skill and safeguarding the lack of it on the part perhaps of staff of inferior competence or regard for the machinery they are handling there is a material attraction towards its use.

The free-barrel brake is applicable to either D.C. or A.C. cranes though with solenoid operation in the case of the latter the A.C. solenoid is considerably more bulky and complicated in its construction than in the D.C. case and there are more connections to make and break and there are also more connecting cables.

Quayside Cranes at Ports—continued

The Centrifugal Anti-overspeed Brake

Frequently a centrifugal anti-overspeed lowering brake is fitted and the most successful of these will shortly be described. The writer's view as regards the necessity for these is that it is generally desirable to get the best speed possible and, in general, a good driver is skilled and interested enough to get it, and will get better speed with safety without, than with, the over-speed brake. But it certainly has to be recognised that not all driver's now-a-days are either skilled or careful, and on this basis, there is much to say both for the over-speed brake and for brakes providing means for the control of lowering as of lifting from the controller alone. Such brakes depend in the case of D.C. cranes for their action on electrical, combined in some cases with electro-magnetic, effects; they are sometimes dynamic where electric retardation is obtained by causing the motor in lowering to generate on to variable absorbent resistances with the current sometimes passed through the exciting coil of a braking electro-magnet mounted round an extension of the motor shaft. Electro-dynamic braking will not of itself bring the load to a full stop, and the point at which braking ceases, and also braking as a whole, may be affected by the condition of the motor brushes, etc., or of control contacts, etc. Potentiometer braking, also applicable in D.C. cases only, is more certain and invariable in its action; it entails some expenditure of live current and is therefore more expensive in this direction than the dynamic method.

Roughly speaking, with it current is passed through a resistance across which the motor fields are variably shorted for varying lowering speeds, the armature being shorted dead or on to a resistance. Sometimes a light shunt winding is provided in the motors. With this method braking can be carried down to a lower, in fact to about creeping, speed.

On A.C. cranes, with the motor reversed to lower and switched full on without rotor resistance, the speed of the load in lowering is held by regeneration to the lifting speed plus twice the slip; insertion of rotor resistance causes speeding-up. Lower speeds and stoppage are controlled by an electro-mechanical brake with foot or hand release as already described.

There is however, for A.C. cranes a method of comparatively recent development of lowering on the controller, with power current in the motor somewhat similar to the D.C. potentiometer method and this will be described shortly.

For very heavy cranes requiring the fullest control of the load and delicate adjustment throughout lowering, one of several mechanical brakes should be fitted; these vary somewhat but, in general, release fully on lifting, but, in lowering, present a frictional resistance requiring the load to be driven down, the friction surfaces being of a nature to present uniform steady resistance and to remain in adjustment over long periods.

Electro-dynamic Control Systems

There are two outstandingly successful and established electro-dynamic D.C. braking and control systems, namely that of Messrs. Lawrence Scott & Electromotors Ltd., and that of Messrs. The Igranic Electric Company, the latter of whom have also principally developed the counter-current A.C. system above referred to, though it has been, the writer understands, used by other firms on occasion.

The main operating faults to be guarded against in the design of control gear are those of too rapid movement of the controller handle, as for example when the operator throws over the handle from "off" to "full-on" as quickly as he can move it and vice versa—which is termed "slamming"—or when he switches from "full-on" hoist or lower to the first, second, or later step in the opposite direction; this is termed "plugging" and is often used by crane operators to bring the load quickly to rest by using the reversal of the motor. Occasionally control gear capable of withstanding "plugging" of this kind is asked for by crane users, so that it can be used for quick stoppages in the regular course of the work of the crane; this obviously requires additional robustness alike in the control gear, the motor, and the mechanical parts.

"Slamming" and "plugging" with straight tramway or drum type controllers would simply cause the motors to flash over and would entirely defeat the purpose of the starting resistance besides bringing the circuit breaker out every time. With A.C. these effects would not be so pronounced, there being no liability to flashing over and the reactance of the motor tending to restrict the current flow.

With potentiometer control, even when contactor operated, but without interlocks, over-fast manipulation of the controller leads to excessive regeneration of braking current, destructive to both controller and motor. With contactors however, it is possible so to control the operation of the contactors and the rate and conditions under which they open and close, however the master controller may be manipulated by the operator, as to safeguard these effects.

The Lawrence Scott & Electromotors control confers full protection, as well as flexibility of control and braking by means of such interlocking gear. Space does not permit of an explanation in detail with diagram, but the following outline of the main features will it is hoped be clear and useful. The controller braking operates in conjunction with an electro-magnetic brake with shunt and series excitation which is normally "off" both in hoisting and lowering, but comes "on" under certain conditions to be explained; this brake is not of the usual solenoid plunger type but is of "magnetic disc" pattern; it will be described later. It embodies also a centrifugal brake controlling top speed. Control is operated by a master controller feeding contactor actuating coils; these coils are fed through ballast resistance and operate by the opening of short circuits across them and not by current being fed to them and, while primarily each actuated through its appropriate master controller drum segment, are further interconnected with each other and with other interlocking contacts to form lock outs, so that they receive current to operate their respective contactors only when conditions are suitable for their doing so; that they operate in proper sequence is also so ensured.

There are seven control steps each way, hoist and lower. Slow hoisting speeds three in number and slow lowering speeds four in number are obtained by the armature diverter potentiometer method, that is a resistance connected across the armature in four and three steps respectively, successively increases the resistance and voltage across the armature. In series across the mains with the armature and diverter resistance, which is cut out on the higher speeds are the starting resistance, the series field winding of the motor, and the series coil of the magnetic brake.

The starting resistance is cut out on the remaining steps 4 hoist 3 lower; the last step not only cuts out all resistance, but also puts a diverter resistance across, and weakens, the series field coil so speeding up the motor. This, however, only comes into effect on loads under about half of full load and is useful on the lowering side for driving down the light hook. It is particularly useful on the hoisting side for light loads requiring faster speeds proportionate to full load speed than are given by the effect of the series characteristic of an ordinary crane motor, or where the motor, for special reasons is compound wound. The diverter contactor is prevented from closing on heavy loads by a load discriminator which when current exceeds a pre-set figure makes contacts having this effect.

Similarly current lock-out coils, preventing the respective contactors from closing until the motor has accelerated and current fallen to a certain limit, are fitted to the main starting resistance contactors, and again voltage lock-outs are fitted to the contactors operating on the armature diverter resistance, preventing them from closing until the voltage across the armature is at a value suitable for the ohmic value of the incoming resistance, so obviating excess current flow.

It will be appreciated that the lower the value of the diverter resistance, the less should be the volts across, and the speed of, the armature and the greater will be for equal voltage its circulating current and dynamic braking effect; and also that current is passing through the field coils on all steps ensuring excitation.

An armature voltage reverse relay is also fitted preventing the directional contactors from closing for reverse motion until the armature voltage has fallen to a suitably low figure; there are various other minor but necessary interlocks and circuit arrangements and re-arrangements provided for protection of coils, excitation of brake coils, etc.

Quayside Cranes at Ports—continued

In the event of the operator slamming over his controller from full lower, with the motor running at the full speed allowed by the centrifugal brake, to No. 1 Step or "Off" or still worse to a hoisting step, the ensuing very heavy dynamic braking current, which would probably cause a flashover at the commutator brushes, is checked by the operation of the lock-outs on the series diverter contactors, which are held out, leaving all resistance in circuit until the armature volts falls. Moreover while the shunt coil of the magnetic brake is so fed through its contactor coil that on the series diverter steps, hoist and lower, the brake is normally held off, in the circumstances described the brake contactor coil is held inoperative by the action of its voltage lock-out and the brake is applied; the effect is to rapidly reduce the speed of and voltage across, the armature, the brake being released when the fall of the armature volts releases its contactor by its circuit being re-made. The brake application is very transient; the main braking is effected dynamically as it would be of course also were the controller brought back at a proper rate when there would probably be no application of the magnetic brake until the "off" position was reached.

The procedure above obtains identically down to "off" when the controller is put over to hoisting from lowering. From the "off" position, while the lowering reverser is released, the hoisting reverser cannot close until the Reverse Delay Relay has closed though the controller drum is in the position of feeding (i.e. unshorting) all the contactor coils; these, however, are prevented from operating by the current lock-outs so long as the current is excessive and until it has fallen to a predetermined value.

The magnetic brake used in conjunction with this control is as aforesaid of magnetic disc type, consisting of a sliding and rotating drum faced on both sides with Ferodo; this disc is gripped between a stationary casing and an armature plate which is pressed into contact with the Ferodo on one side of the disc by a series of springs applied to the back of it. Behind it, are shunt and series exciter coils operating and connected as above described; the series coil on the steps beyond the armature diverter ones is fitted with a diverter resistance. Excitation of these coils releases the brake by attracting the armature plate and overpowering the springs.

Inductive Time Limit

The Igranic control is characterised by its method of effecting time-lag on the closing of the accelerating contactors embodying what is termed Inductive Time Limit (I.T.L.). Its general features embody the usual reversing (or plugging) contactors and a series of resistances cut out, for hoisting, in steps by contactors together with a series magnetic brake. On the first hoisting notch all resistance is in series and the current passed is sufficient only for half full load torque; this notch is principally useful for taking up slack rope and otherwise giving creeping speeds with light loads.

For lowering, braking is potentiometer with field excitation from the mains throughout, the series field, having part of the resistances in series with it, being put in parallel with the armature so that the motor is connected as a shunt machine. The first notch is naturally that on which the heaviest braking takes place. On it only one section of resistance, common to both armature and field coil, is in circuit with an additional section in series with the armature; full load will run down at about quarter of full speed. On subsequent notches the resistance contactors open and increase the speed at which the flow of braking current balances the descending load, first by inserting resistance in both the armature and the field coil circuits, subsequently by further increase in the latter and on the final notch by cutting out all resistance in the armature circuit and inserting all available resistance in the field circuit, light hook running down at about $1\frac{1}{3}$ and full load about $1\frac{3}{4}$ full speed.

In returning the controller handle for slowing down, the action is of course reversed, the field strength being increased and resistance replaced in the armature circuit; to prevent excessive flow of braking current the closing of the contactors is delayed under I.T.L. time-lag control.

In the "off" position, a contactor closes to form a dynamic braking loop of armature, part of the total resistance, and field coil in series without external excitation; this contactor opens when the master controller is moved either to hoist or lower, but when first closed, in conjunction with a relay excited from the armature, after a time-lag operates two contactors cutting out a major portion of the resistance and sets up a dynamic braking current flow which, materially assists the mechanical brake. The relay, being de-energised when the motor stops, falls out, and with it the two resistance contactors.

Plugging is safeguarded by the closing of the plugging contactor being delayed until the motor has come to rest ready to reverse.

The contactors are fitted with hold-out coils ensuring their closing in proper sequence and each at a suitable interval after its predecessor.

The I.T.L. arrangement controlling this is roughly as follows:—

A solid core transformer is provided with a coil for each contactor plus a coil for the plugging switch. In series with these respective coils are the hold-out coils of the corresponding contactors; the two are together connected across the sections of resistance cut out by the contactors, but with one step in advance, that is, transformer coil No. 3 and the hold out coil of No. 3 contactor are connected across No. 2 contactor and are short circuited when this contactor closes, and so on, successively, except that the transformer coil and holding out coil of the first contactor cutting out resistance are simply short circuited on each other.

A magnetic flux is set up in the transformer core by the flow of the currents in the respective transformer coils and the effect attained is that as variations take place of the current in the coils as contactors close and short circuit them, due to the changes of flux, transient currents are set up which hold out the contactors for a period dependant on the adjustment of the magnetic circuit of the hold-out device.

Thus the hold out mechanism of say No. 3 contactor is operated by the current flowing in its hold-out coil from its connection across the preceding resistance section No. 2 until the contactor of this latter has closed, but if its (that is No. 3) control circuit is closed prematurely, as for example by the control handle being thrust over, the transient currents, induced by the changes of potential and of consequent transformer flux, in the now short circuited No. 3 hold-out coil, hold out No. 3 contactor for a suitable period predetermined by adjustment of the magnetic circuit of the hold out device.

The first accelerating contactor, the hold-out coil of which, as already explained, forms a short circuit on its transformer coil, is held out by the effect on the transformer flux of the closing of the plugging switch.

The transient currents of course persist only so long as changes in current flow give rise to changes in the transformer flux, and fall away to zero, releasing the contactor hold-outs, when conditions become stabilised whether the main current then passing is low or high. The possibility of contactors being held out permanently under heavily loaded or breakdown conditions is thus avoided; such conditions are taken care of by the overload cut-out. The transient current control of contactor hold-outs applies to all contactors including the plugging switch on which there is little effect when starting from rest, but which is prevented from closing to reverse the motor until it has stopped if the master controller be thrown over from hoist to lower or vice versa.

Condenser Time Limit

An alternative to the Inductive Time Limit is the Condenser Time limit. It has been found that longer timing can be obtained with condensers connected across the hold-out coils than with the inductive method; the hold-out coils of each contactor are then respectively connected across the lines through normally closed interlocks on the preceding contactors with a condenser across each. The closing of the preceding contactor dis-connects the hold-out coil from the lines and the condenser discharges through the hold-out coil and prevents the contactor from closing until it, i.e. the condenser has discharged. The condenser method enables the time limit contactor control to be applied to A.C. cranes. Rectifiers are used to supply D.C. for the operation of

Quayside Cranes at Ports—continued

the hold-out coils and the charging of the condensers. The inductive system is of course not workable with A.C. equipment.

A.C. braking on lines comparable to D.C. dynamic or potentiometer braking is operated on what is termed the counter-current system. While according to the writer's information the method has been applied by other firms it, together with its methods of control, has been most fully developed by the Igranic Company whose control appears to be that most extensively in use on A.C. cranes in this country.

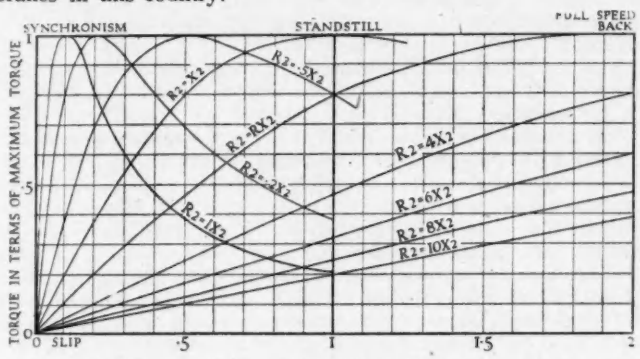


Fig. 11. Diagram of Torque Slip with varying resistance between sliprings showing principle of counter-current braking. (Igranic Electric Co.).

Counter current braking depends for its action on the characteristics of wound rotor polyphase motors as illustrated in diagram Fig. 11. As is well known, for starting purposes resistance is inserted between the rotor slip rings of polyphase motors; this has the effect of increasing slip and with it torque up to a maximum known as the "Pull-out" torque of the motor. Further increase of resistance increases the slip, but decreases the torque, so that by the insertion of resistances of sufficiently high ohmic value the torque developed becomes less than full load torque. Under these circumstances with the motor control set for hoisting, the motor will be actually overhauled by the load, which will lower against the counter torque developed which is, of course, adjustable according to the resistance inserted in the rotor circuit on the respective lowering notches. As shewn by the diagram, the effect is the same when the motor is reversed, i.e. when the slip is greater than 100%, as when it is less. In practice, it is found sufficient, and advantageous in respect of the amount of resistance required, to insert resistance in one only (i.e. between two only of the slip rings) of the rotor phases, the other two phases being open circuit.

In general, lowering speed can be controlled by counter-current braking down to 10 to 15% of full speed, final stoppage being effected by the mechanical brake, which is generally of the automatic electro-mechanical type. Lowering can, of course, if desired be done by easing off this brake by mechanical release. A refinement is to fit an auxiliary motor of one-fifth the power of the main motor with which slow lowering of any load down to light hook can be effected; this appears to the writer to be unnecessary in general, but may be useful in exceptional cases.

On the "lower" section of the control beyond the counter-current notches there are further notches giving power lowering; the first of these connects the motor across the mains in the lowering direction without resistance in the rotor; this gives a regenerative braking control with lowering speed above synchronous speed by the amount of the slip due to the internal rotor resistance. Further notches insert resistance in the rotor circuits and increase the negative slip and lowering speed accordingly up to about 1½ times normal hoisting speed.

The general operation of the control is similar to that of the D.C. control already described, the time lag currents holding out the contactors being D.C. supplied by condensers which in turn are fed together with the hold out coils from small rectifiers.

Hoisting is pretty well normal; on the first notch the two direction setting contactors close for hoisting and the closing of interlocks on them energises the resistance contactors controlling and cutting out the high resistance for counter current braking; the contactors close in sequence but without starting the motor.

On the second notch a contactor is energised which has its hold out coil connected, through a rectifier and an adjustment resistance, across the rotor. This hold-out coil prevents the contactor from closing when the controller is plugged over from lower to hoist or vice versa until the motor has come practically to rest. The closing of this contactor completes the motor circuit for running. The remaining double pole contactors close on succeeding notches in sequence under a condenser time limit control connected as described above, cutting out starting resistance until full hoisting speed is reached.

For lowering, the motor will not start electrically on the first five notches, these being braking notches. On the sixth notch the lowering contactors close, followed in sequence under time limit control by the resistance contactors so putting the motor across the mains in the lowering direction. Movement on to the 7th notch opens two of the contactors and inserts resistance in the rotor circuit thus raising the lowering speed. On moving back to the fifth or earlier notch, the contactors setting the motor direction for lowering drop out, and the hoist contactors are closed connecting up the motor in the hoisting direction for counter current braking, the closing of these contactors taking place as soon as the lowering contactors drop out.

On notches below the fifth the resistances in the rotor circuit are successively reduced increasing the counter torque and slowing lowering speed on the 4th, 3rd, 2nd and first notches. When the

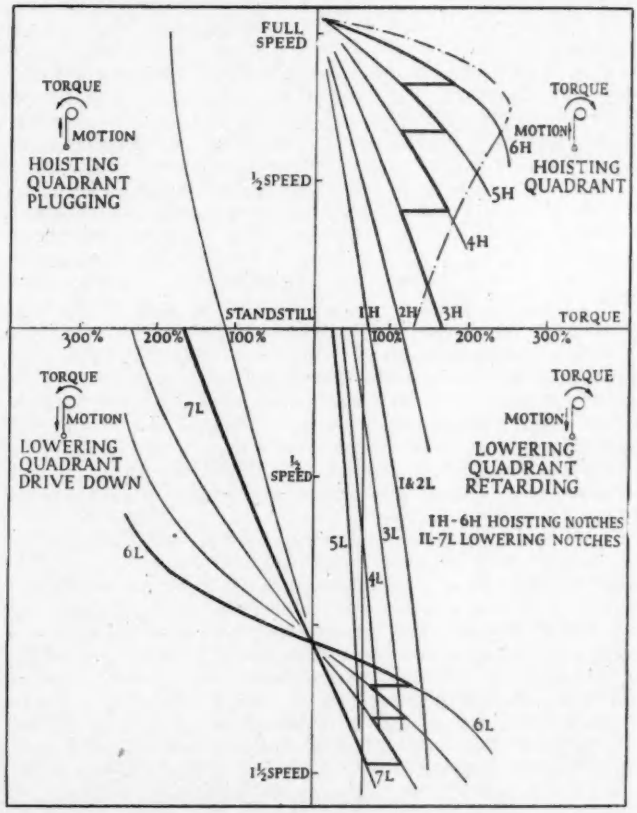


Fig. 12. Speed Torque Curves showing lowering speeds available with counter-current braking. (Igranic Electric Co.).

speed of the motor drops below 10% of normal a relay excited from the rotor voltage drops out with the effect in turn of dropping out the hoist contactors. This prevents the hook from moving upwards on any of the lowering notches should the counter current braking torque by any chance exceed that required to lift the load, as for example on very light loads. The action of this relay has also the effect that if the controller is moved very rapidly to

Quayside Cranes at Ports—continued

the off-position the electro-mechanical brake is not applied until the motor speed has dropped to about 10% of full speed.

Diagram Fig. 12, shews the speed torque characteristics of the motor under this control on each notch. For example, assuming full load on the hook the torque required to balance the load is approximately 70% of the normal full load hoisting torque and it will be seen that the 4 L curve crosses the 70% line at about ¾ full speed and the 3 L curve at about a ¼ full speed, so that with full load on the hook two lowering speeds are possible. A suitable lowering speed for any load can be found on one or other of the braking notches.

A refinement of this system has been developed in which the amount of resistance in circuit is made to depend on the speed of the motor, the scheme being known under the name of "Opotor."

Control Gear: General

Compared with the throttle and reverse brake and clutch lever control of the steam crane, and the still simpler valve levers of the hydraulic, constructionally at least, electric control gear is very complicated. It has the merit operatively, however, of the control of every movement being reduced practically to that of moving a lever or handle in the appropriate direction and at a suitable speed. Also, as has been made clear, it can be arranged to defeat carelessness or recklessness in handling on the part of the operator.

It is only, however, by employment of contactor control that this can be ensured. For motors up to 50 or 100 h.p. tramway or drum type controllers are suitable and were almost universally used in earlier days, but while quite suitable and satisfactory in the hands of skilled and careful operators, they cannot be arranged with automatic safeguards. They can of course be arranged with suitable contacts to provide for dynamic and potentiometer braking if required but not for time lags and interlocks. Above 100 or even 50 h.p. on a heavily operated crane, contactor control should be used from the point of view of maintenance and reliability apart from any question of interlocking safeguards.

In any type of control gear, wear from sparking and burning should be confined as far as possible to a minimum of parts which should be easily and cheaply renewable and these renewal portions should be designed to be confined to the parts immediately affected; it should not, for example, be necessary to take out and scrap ½lb. or so of copper or carbon to make good ½oz. burned away.

It is, of course, easy to arrange with any type of control for auxiliary circuits such as that of a solenoid brake being brought into action at any chosen time, for example a brake may be released on the first lowering notch to let the load run down without current going to the motor though in most cases it is better to do this by mechanical release on the brake itself as giving better control of the load

It is likewise possible on free barrel cranes to declutch by means of a contact on the first lowering notch of the control, but, as already remarked, this should be accompanied by the provision of an interlock preventing the clutch from re-engaging in the event of current failure outside the driver's intention and control. Another interlock which may be fitted in this connection would prevent the barrel being declutched before the driver has his foot on the brake pedal, but it is questionable whether it is not better to trust to the driver's skill than to provide such safety measures. Certainly in some of the earliest cranes with which the writer had to deal, and which have already been referred to, there were no such safety interlocks, the free barrel being clutched into engagement by a series solenoid when current was switched on, and being therefore automatically freed immediately current was switched off and hoisting ceased and as already indicated they worked to the writer's knowledge over 30 years without accident.

Current Collection

Current collection in the case of semi-portal cranes is frequently done from trolley wires and in some circumstances of full portal cranes collection is effected from trolley wires run in an underground conduit. This is not altogether ideal in view of possible troubles from damp, dirt, refuse, etc., or even the influx of flood water.

A German system which was used in one set of cranes, with which the writer had to deal, carries the trolley wires in a metal boxing above ground provided with lids in sections which are opened up successively as the crane travels by a plough thus allowing for a more substantial form of mounting for the collectors than in the case of a conduit with a slot. It is a drawback that the conduit or box is above ground forming an obstruction.

Trolley wires and poles are of course not feasible with quayside cranes on account of the danger of wires being fouled.

Altogether the question of current collection for quayside cranes is rather a thorny one and probably the most satisfactory method of conveying current to them is either by plug sockets at intervals and flexible cables of length sufficient to give reasonable travel before the plug has to be moved to another socket or by the Dalite drum system with which the drum revolves and the flexible cable winds up on itself like a watch spring, or is pulled out by the crane as it recedes. The drum is of course fed through slip rings and brushes.

Constructional Features.

As regards constructional features self-lubricating pulleys are becoming general and it is now frequent to use worm gear reduction between the motor and the winding drum, the gear being, of course, quick pitch and of high efficiency with ball or roller journal and thrust bearings.

As regards mechanical strength, regard must be had that the motors specially with D.C. may on occasion develop many times their rated torque if obstructed, as in the event of a hook catching in the hatch coaming. It may be argued that protection is afforded by the circuit breakers, but these come out after and not before the current rush which sets up excess torque. It is, therefore, necessary to allow for these conditions in specifying the factor of safety to be allowed in the working parts and structure of the crane and particularly the wire ropes.

Stability is not affected to the same extent, as the circuit breakers, though they cannot prevent excessive snatch, do prevent it from being maintained long enough to overturn the crane. Generally, the writer considers a crane should be stable up to 100% overload, with the jib seawards, and vice versa and up to 50% overload with the jib at right angles to the carriage. Where cranes as is frequently the case are specified for two rated full loads generally one to two of each other, a temptingly cheap and simple way of getting this is by working the light loads on single rope and for the double loads to double the rope up through a snatch block and hook up the end to the jib head. This will not work with certain types of level-luffing gear.

Experience of this method is that it is very unsatisfactory, especially when doubling up requires to be done on a dark night and in a gale of wind and rain. Also the heavy snatch block is a drawback in hatches. It is therefore much preferable to get the two speeds by change gear in the cab.

The Port of Peniche.

The Engineer Director-General of the Portuguese Hydraulic and Electrical Services of the Ministry of Public Works and Communications (Senhor Duarte Abecasis), has called attention to the necessity for one or two corrections in the translation of his article on The Port of Peniche in the July issue:

Page 51, second column, line 22: " without producing more than slight cracks " should read " without producing the slightest crack between the older portion and that which constitutes the widening of the superstructure."

Page 53, first column, line 6: for "barages" (a misprint for barges) substitute " craft."

Page 55, first column, line 9: " cold storage industry " should read " canned fish industry."

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

The Design of Jetties

By R. R. MINIKIN

(Concluded from page 126)

Stability of Soil.

It will be appreciated that when a blow is delivered on a pile, or system of piles, by a moving vessel the ultimate absorption of the energy of the blow is in the ground. Neglecting the weight of the structure, the problem then is: that a pile subject to some horizontal force, such as the blow delivered by a moving vessel, is held in place by the resistance of the ground to lateral displacement. We can assume, with some justification, that the opposing force is of the nature of passive resistance of the ground over the embedded length of the pile. We know that the passive resistance varies in intensity with the depth, that is $p = mc_3 x$ where c_3 is the hydraulic equivalent of the ground, and m is some co-efficient, see Fig. 4. Now for equilibrium, the horizontal force applied at some height l above the bed level must be opposed by a resisting couple in the ground. As most soils are compressible and of low shear resistance, the tendency will be to displace the pile, in the plane of the force, about some fulcrum 0 at a depth ah below the surface. We also know that the passive resistance of soils cannot be mobilised until there is some movement; and as the displacement varies with the distance from the fulcrum 0, the amount of the passive resistance of the soil effectively mobilised will necessarily be less than that shewn by the diagram at (a) Fig. 4 (about the same fulcrum 0). At the commencement of movement there is an ultimate opposing resistance shewn by the diagram (b); if now the pile subject to the horizontal force is assumed to remain straight, the displacement at any depth x below the surface is $s\left(1 - \frac{x}{ah}\right)$, where s is the displacement at the surface. Therefore, providing we can evaluate m in terms of the passive resistance potential the intensity of the resistance per unit width to lateral displacement at any depth x is,

$$mc_3 s\left(1 - \frac{x}{ah}\right) x = m\, c_3\, s\left(x - \frac{x^2}{ah}\right)$$

$$\text{and } P = m\, c_3\, s \int_0^h \left(x - \frac{x^2}{ah}\right) dx$$

$$= m\, c_3\, s\, h^2 \left(\frac{3a - 2}{6a}\right) \quad \ldots\ldots(4)$$

Taking moments about 0.

$$P(1 + ah) = m\, c_3\, s \int_0^h \left(x - \frac{x^2}{ah}\right)\left(ah - x\right) dx$$

$$= m\, c_3\, s\, h^3 (a/2 - 2/3 + 1/4a) \quad \ldots\ldots(5)$$

$$\text{where } a = \frac{4l + 3h}{6l + 4h}$$

$$= 1 - \frac{n}{1 + 3n}$$

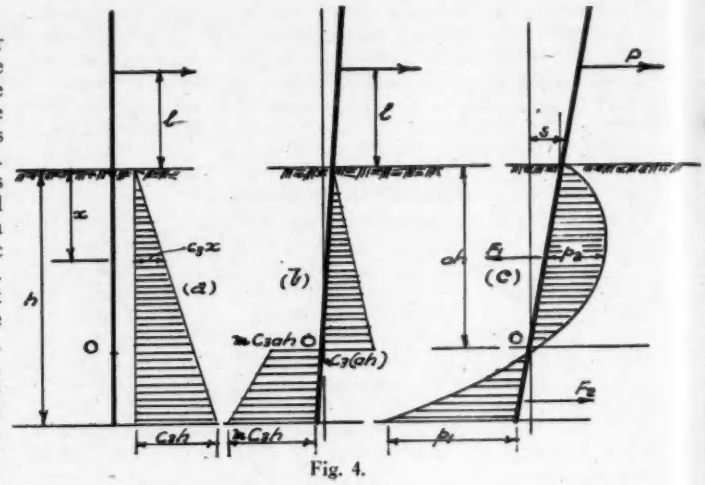
$$n = (2l/h + 1)$$

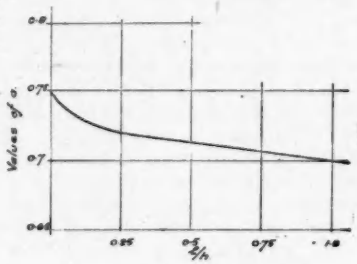
$$\text{and } p_1 \max = \frac{6\,Pn}{h\,d} \quad \ldots\ldots(6)$$

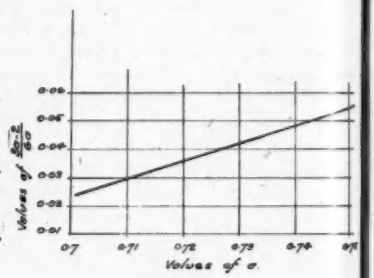
$$p_2 \max = \frac{a^2}{4(1 - a)}\, P_1 \quad \ldots\ldots(7)$$

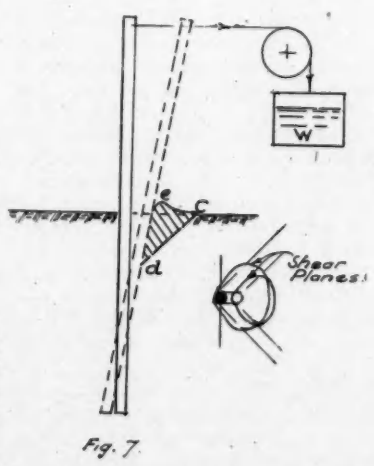
The diagram figs. 5 and 6 shew the values of $\left(\frac{3a - 2}{6a}\right)$ and a.

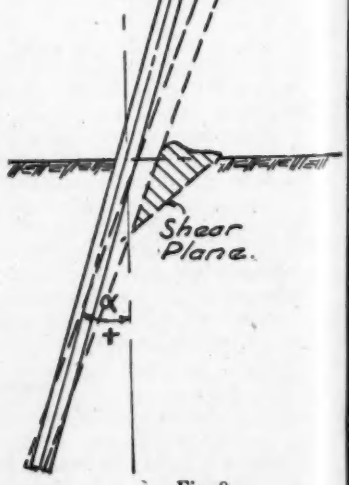
It can be easily verified by experiment that if a pile be driven into level ground and then subjected to a horizontal force the first signs of rupture of the soil occur in the portion e c d Fig. 7, near the top of the pile. As explained later in this paper the shape of the ground fracture, in plan, shews at about 45 deg. on both sides of the line of the direction of force. This appeared to the author to indicate that to shear such a section a force greater than that commonly taken as the passive resistance on the contacting surfaces would be











The Design of Jetties—continued

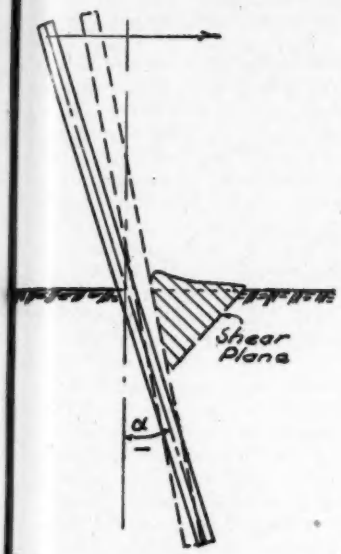


Fig. 9.

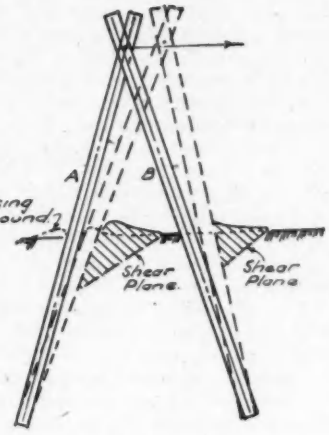


Fig. 10

required. He therefore devised a series of experiments in a model apparatus as shewn in Fig. 11. A wall b, 6″ wide and 6″ deep connected to a lever arm a hinged at 0 was placed in a box which could be filled with the soil to be tested ; a liquid weight W supplying the force. Close watch was kept for the first signs of rupture by shear which was usually signalled by a slight heaving of the surface. Records were taken of W and angle α. After a number of tests were made with a particular material the 6″ wall was taken out and replaced by two fixed plates leaving a gap 1″ wide between them. Into this gap a hinged flap 1″ wide was placed and tests similar to the above were made. Following this, further tests were made with 1″ square piles in the centre of the box as shewn at C. The tests of the pile were almost equal to the 1″ wide flap. From these experiments it was found that if C = co-efficient of passive resistance of the wide wall then mC = co-eff., of passive resistance of the narrow flap and pile. For sand the value of m = 2·3 to 3·4, and for moist sandy clay m = 1·3 to 1·7.

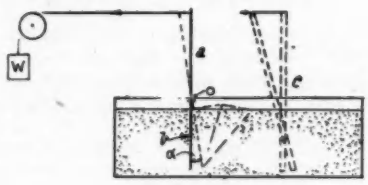


Fig. 11.

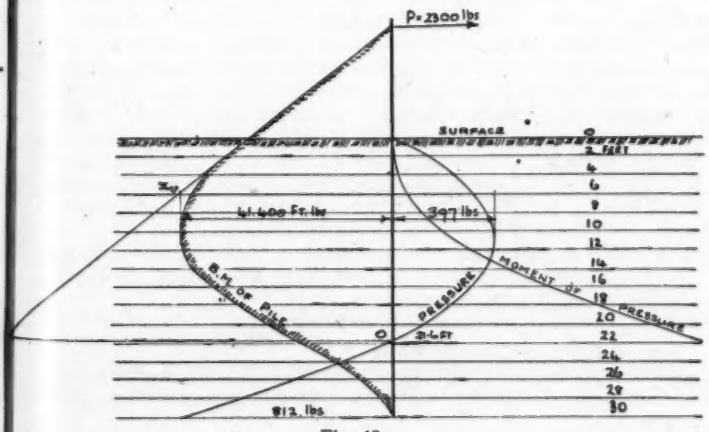


Fig. 12.

At visible fracture, when the angle α is recorded the displacement of the toe of the wall is approximately d sin α. This is no doubt greater than at the moment of actual failure. To become visible, work must be done in disturbing and raising the particles of the mass moved. It was noted in the course of the experiments that where a pile was displaced at the surface of the ground a distance of approximately 0·3 ah sin α that it did not recover its original position on the release of the load. It was therefore concluded that this represented a critical displacement, and that the generally accepted passive resistance co-efficient C for a pile subjected to a horizontal force should be increased by the amount m as shewn in b, Fig. 4. On these assumptions the diagram of Fig. 12 is constructed shewing the distribution of pressure curve ; the bending moment due to the ground pressure, and the resultant bending moment on the pile. It will be noted that the virtual depth of fixity is at H_3 approximately 0·3 ah below the surface.

Where the toe of the pile is driven into good ground and the body is embedded in ground of a poorer nature, the above argument is modified by assuming that the fulcrum 0 is at the foot of the pile, and that the lateral displacement instead of being a straight line through the fulcrum, is bent as indicated in Fig. 13. A very close approximation to this curve in the embedded portion is $(1 - x/h)^2 s$ so that the pressure at any depth x below the surface is

$$m\, c_3\, s \left(x - 2\,\frac{x^2}{h} + \frac{x^3}{h^2}\right)$$

$$\text{and } P = m\, c_3\, s \int_0^h x - \frac{2x^2}{h} + \frac{x^3}{h^2}\, dx$$

$$= m\, c_3\, s\, h^2/_{12} \qquad \ldots\ldots(8)$$

Taking moments about 0.

$$P\,(1 + h) = m\, c_3\, s \int_0^h \left(x - \frac{2x^2}{h} + \frac{x^3}{h^2}\right)(h - x)\, dx$$

$$= m\, c_3\, s\, h^3/_{20} \qquad \ldots\ldots(9)$$

The bending moment and pressure diagrams for this case are shewn in Fig. 13. The expressions (4) and (5) are more suitably applied to stiff piles driven into homogeneous ground of a soft nature, whereas expressions (8) and (9) are probably the more practical and generally applicable to average conditions.

Example.—A 12″ sq. R.C. pile 4% reinforcement I = 2700 ins. concrete units is subjected to a horizontal force P at 12 ft. above bed level ϕ = 30 deg. Maximum compressive stress in the concrete due to the force not to exceed 1,000 lbs. per sq. in.

$$\text{Moment of resistance of pile} = \frac{f\,I}{y} = \frac{1000 \times 2700}{6}$$

$$= 450{,}000 \text{ in lbs.}$$

at 20 ft. embedded length a = 0·71 and ah = 14·2 ft.
25 ,, ,, ,, a = 0·715 ,, ,, = 17·8 ,,
30 ,, ,, ,, a = 0·72 ,, ,, = 21·6 ,,
Virtual free length = 1 + 0·3ah
at 20 ft. embedded length = 16·26 ft.
25 ,, ,, ,, = 17·25 ,,
30 ,, ,, ,, = 18·48 ,,

$$\text{Then } P_{20} = \frac{450{,}000}{12 \times 16{\cdot}26} = 2{,}300 \text{ lbs.}$$

$$P_{25} = \frac{450{,}000}{12 \times 17{\cdot}25} = 2{,}160 \text{ lbs.}$$

$$P_{30} = \frac{450{,}000}{12 \times 18{\cdot}48} = 2{,}040 \text{ lbs.}$$

Now $P\,(1+ah) = m\, c_3\, s\, h^3\, (a/2 - 2/3\ 1/4a)$

$$2300 \times 26{\cdot}2 = 1{\cdot}4 \times 100 \times \left(\frac{1+\sin\phi}{1-\sin\phi}\right) s \times 20^3 \times 0{\cdot}041$$

from which $s_{20} = 0{\cdot}435$ ft.
at 25 ft. depth

$$2160 \times 29{\cdot}8 = 1{\cdot}4 \times 100 \times \left(\frac{1+\sin\phi}{1-\sin\phi}\right) s \times 25^3 \times 0{\cdot}04$$

from which $s_{25} = 0{\cdot}242$ ft.
at 30 ft. depth

$$2040 \times 33{\cdot}6 = 140 \times 3s \times 30^3 \times 0{\cdot}04$$

The Design of Jetties—continued

from which $s_{20} = 0{\cdot}178$ ft.

Taking expression (9)

$$P(1 + h) = m\, c_3\, s^{h3}/_{20}$$

at 20 ft. depth

$$2300 \times 32 = \frac{140 \times 35 \times 20^3}{20}$$

from which

$s_{20} = 0{\cdot}435$ ft.

and as before

$s_{25} = 0{\cdot}242$ ft.

$s_{30} = 0{\cdot}178$ ft.

Now critical displacement $= 0{\cdot}3ah \sin a$ and as $a = 6$ deg. for sandy clay $\sin a = 0{\cdot}1045$ so we get

Critical displacement 20 ft. depth $= 0{\cdot}46$

" " 25 ft. " $= 0{\cdot}57$

" " 30 ft. " $= 0{\cdot}68$

Therefore the factors of safety in ground values for these 3 depths are for

s_{20} .... 1·06

s_{25} .... 2·35

s_{30} .... 3·8

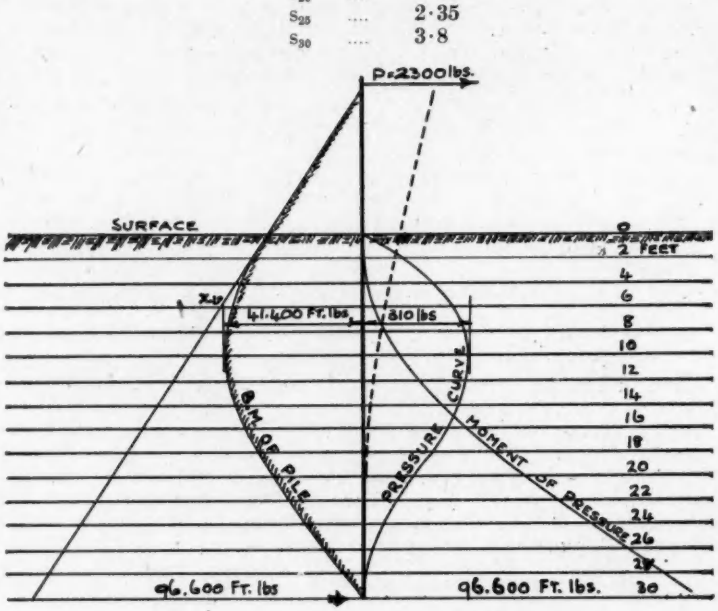


Fig. 13.

From which we deduce that the embedded length of pile should not be less than 24 ft. for a minimum factor of safety of 2.

In the model experiments which the author carried out in natural sandy clay the following brief summaries give a good indication of the ground behaviour. The model piles used were of $1\frac{1}{8}$" rods of hickory and teak and 1" and $\frac{3}{4}$" diameter steel tubes.

(*a*) Vertical piles, Fig. 7.—These were driven to various depths of 12 to 20 diameters and subjected to a horizontal force applied by means of a rope passing over a pulley and weighted by water poured into a suitable vessel, as shewn. The load was applied gradually until failure of ground by visible shear. The general form of rupture was fan-shaped at the surface. It will be noticed that there are four distinct cleavage planes radiating at approximating 45 deg. from the pile as centre and on the side in the direction of the force.

(*b*) Pile raked in the direction of the force, Fig. 8. The force required to bring about ground failure in this case was appreciably greater than that required for case (*a*) and from a number of tests it was found to be approximately $(1 + \sin a)$ p where p is the force required for case (*a*) embedded lengths were the same in all cases : *a* is the angle of the pile to the vertical : positive when raked in the direction of the force.

(*c*) Pile raked against the direction of the force, Fig. 9. This angle of slope shewed a lesser ground resistance and was approximately $(1 + (-\sin a)\, p = (1 - \sin a)\, p$ where values are as above.

In all three cases the rupture of the ground in the vertical plane was visible at an average depth of 4 diameters below the surface of the ground.

(*d*) Triangulated piles, Fig. 10. Two raked piles driven to 12 diameters depth at a slope of 1 in 3 and hinged at 0, 12 diameters above ground surface. Using 1" diameter piles of teak there was a definite structural deflection before ground failure. The first signs of rupture shewed around the leg A as a circular rising of the ground surface concentric to the centre line of the pile A. It was approximately 4 diameters of the pile in diameter. As the structure heeled over the ground humped slightly in front of each pile as shewn in Fig. 10. This was followed by a definite cleavage of the surface near leg A similar to case (*a*), Fig. 7, whereas the cleavage at leg B was of a lesser magnitude. Two piles driven to 18 diameters depth held rigidly in place at double the pull of the cases above driven to 12 diams. There was only slight movement of the ground which recovered on release of load.

In very few cases has the author found designers to make any definite allowance for the absorbing effect of the ground on the shock of impact on jetties. Most of them appear to be satisfied by the assumptions of a fixity depth of 5 feet for good ground, and 10 feet for poor ground, and a transverse velocity of approach of vessel of 60 feet per minute, neglecting the longitudinal thrust. Where the impact forces are too great to be taken by vertical piles only, recourse is had to opposing rakers of inverted V pattern at selected bents : the author however favours groups of 4 piles placed pyramid fashion, as they are the rational safeguard for impact stresses. There are two widely used methods for computing the value of rakers : first, that the allowable horizontal force does not exceed 2 (R — T) sin *a*, where R is the safe axial load on pile and T is the assumed pressure value at the toe : second, the allowable

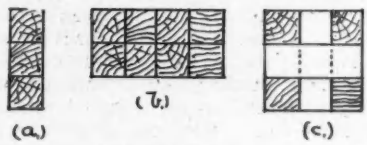


Fig. 14.

horizontal force is computed from the resolved safe axial loading of the pile and the deformation of the system evaluated. Then the work expended on this deformation is the equivalent kinetic energy absorption value of the system. Both cases entirely neglect the effect upon the ground and therefore cannot give even near approximations.

The point is, that the embedded depth and the nature of the ground are essential factors of the stress analysis. If for example the piles were driven through mud into a chalk layer, the tension value of the near side pile would be considerably less than the compression value of the further raker and therefore as a system would not depend upon the strength value of the piles themselves ; it is therefore necessary to deal with raked piles in the same manner as vertical piles, that is, to investigate the soil stability of the embedded portion.

The use of fender piles and mechanical accessories, such as springs, cork and rope fender coils, and floating fenders are of great value to reduce the maximum pressure on the structure. There is a great diversity of practice in the use of fender piles ; some are single piles rigidly connected to the jetty at the head, others are single in width but bolted together two or three deep, resting at the head against a rope coil and assisted at water level by a floating fender ; yet again others as those are built up of 8 piles placed 4 close abreast and 2 deep, bolted and braced together, as shewn in Fig. 14 in (*a*) and (*b*). A mean between the two as, say, group (*c*) would give considerably better results.

The author trusts that the foregoing remarks will be accepted as constructive criticism and lead to a closer analysis of the factors involved in piled jetty design.

Death of Former Harbour Master

The announcement is made of the death at Padworth, Berks., of Captain F. N. Halley, formerly Harbour Master of Basra and Abadan.

Movable Bridges across Port Waterways

*Development of the Chicago Type Bascule Bridge**

By DONALD N. BECKER,[1] M.Am.Soc.C.E.

(Concluded from page 138)

The Refinement Period 1923—1941

In 1920 funds were becoming scarce, with the result that in 1923, 1924, and 1925 no more bridges were added to the list. However, between 1924 and 1930 several more bond issues were approved by the electorate and in 1926 bridge development was resumed. This period, however, did not produce the radical improvements that marked the years 1911 to 1922. In 1924, when the 100th Street bridge over the Calumet River (see Fig. 15) was proposed, it was decided to avoid all patents, even the internal rack patent held by Mr. von Babo. Mr. von Babo's patent had been used by the city without compensation because he developed it while he was a city employee, although the patent had never been assigned to the city. To overcome this complication, a rack was attached to the side of the truss instead of in the plane of the truss. Instead of the cross girder the inner trunnions were supported on a longitudinal **S**-shaped box girder in which the rear end of the girder passed over the counterweight box, but yet under the roadway to a support over the anchor

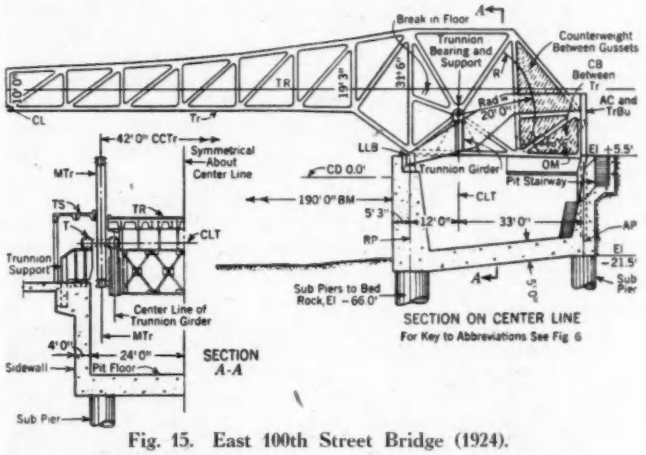


Fig. 15. East 100th Street Bridge (1924).

pier. In principle this was similar to the idea used as far back as the North Western Avenue bridge completed in 1904, where a tapered box girder was used. In this new development, by using curves it was possible to deepen the section for movement under the trunnion. Near the ends where the depth is less than under the load and where only shear governed, the web plates were reinforced with additional side plates. This support was only used for the inside journals, the outer ones being supported upon short stubby cantilever girders anchored in the sidewalls and set transversely across the bridge, thus simulating a cross girder with the centre section passing through the trusses cut away. A change was also made in the machinery supports, the unit bed frame being now set directly upon the masonry of the side-walls, which are suitably reinforced with metal grillages embedded in the masonry and with holding-down bolts effectively anchoring the machinery into the masonry. Here another of the recommendations in the 1900 Report of the Board of Consulting Engineers was finally, and most effectively, adopted.

One of the bridges of this period, that at West Adams Street, is interesting in that local conditions on each side of the river forced a different tail-end design on the two sides of the river (see Fig. 16). This bridge is set at such a high grade that a deck bridge was feasible; but, due to the shallowness of the rear arms, an internal or side rack was not feasible, so the rack was placed outside and below the bottom chord in the plane of the member.

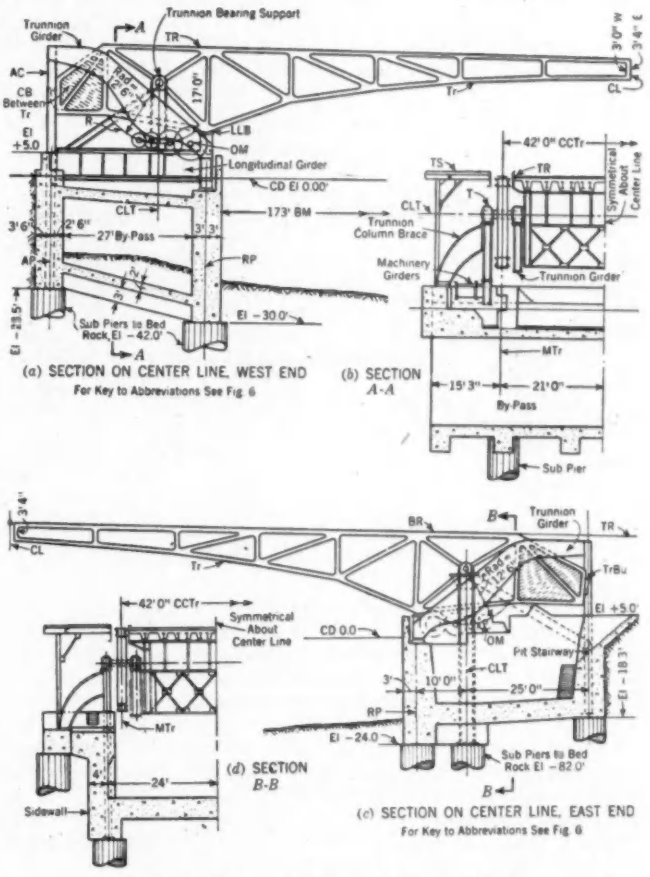


Fig. 16. West Adams Street Bridge (1926).

The machinery on the east side rested directly on the masonry as described in the previous paragraph, but on the west side it was impossible to use the usual pit as a by-pass through the masonry because added flow area in the river was required. Accordingly, the outer trunnion supports and the machinery rest on longitudinal girders spanning from front to rear piers, whereas the inner trunnions rest on **S**-girders. On the east side the outer trunnions rest on trunnion columns and the inner ones on **S**-girders. The counterweight arm on the west side was so short that only a shallow pit was required, because (1) the by pass, and (2) a railroad track on the west dock, did not permit extension that way. This made it necessary to reduce the volume of the counterweight box below the most desirable dimensions. To overcome this condition and to provide the weight required, con-

*Reproduced from the Journal of the American Society of Civil Engineers, February, 1943.

[1]Engineer of Bridge Design, Dept. of Public Works, City of Chicago, Chicago, Ill.

Movable Bridges over Port Waterways—continued

crete made with steel punchings to produce a unit weight of 275-lb. per cu. ft., combined with shaped iron castings, and a small amount of lead pigs were used, thus adjusting the centre of gravity to produce an over-all unit weight of about 330-lb. per cu. ft.

When the South Halsted Street bridge (see Fig. 17) was being designed, a problem was presented because the U. S. War Department urged higher river clearances. Combined with the fact that the street passes through a subway under a railroad just south of the bridge, this requirement would have made almost prohibitive grades on the bridge approach unless the bridge grade were kept as low as possible. The grade was reduced by using three trusses and a very shallow floor system, the floor beams consisting of 30-in. Carnegie beam sections with the total depth of the deck only 3.5-ft. from the roadway grade to the underclearance. As this bridge has two three-lane roadways, it does not give the same constricted appearance as the older three-truss bridges, with only 18-ft. roadways.

These same plans were used at South Ashland Avenue bridge, a mile west of the South Halsted Street bridge (1938), not on account of local conditions but in order to use plans that would fit the location and provide a job under PWA without the delay of preparation of new plans. These plans, with the shallow floor, however, had the advantages of keeping the hump in the street profile at a minimum.

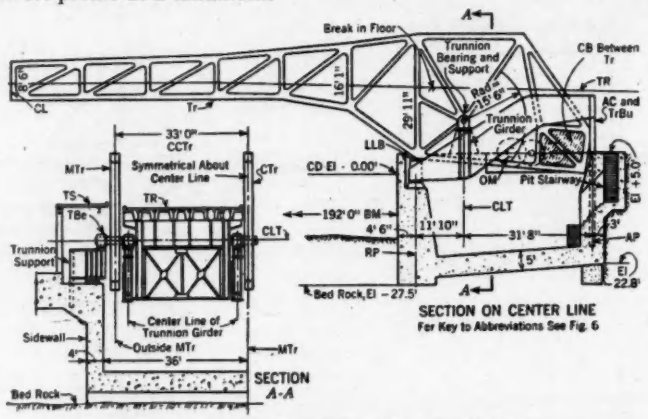


Fig. 17. South Halsted Street Bridge (1933).

The railing-height truss idea, first used for the Madison Street bridge (1922), was used again at the North Wabash Avenue bridge (1930) and the North State Street bridge (1942). However, silicon steel was used instead of nickel steel. The Wabash Avenue bridge (Fig. 18) was awarded the first prize by the American Institute of Steel Construction as the best looking bridge completed in 1930 in the class costing more than $1,000,000. This bridge has a six-lane divided roadway. The centre island was used as a protection for a row of T-shaped trolley supports, thus avoiding the necessity for arches over the roadway. These T-shaped trolley arches were preferred to rather flat arches otherwise required.

The North State Street bridge (Fig. 19) is a three-truss bridge because it provides for eight lanes of traffic, and it is not feasible to design floor beams to span the width required for two additional lanes, without a further rise in grade. With such wide roadways the old danger that existed with four-lane roadways of vehicles running head on into the centre trusses is not so great; at least, it is not as bad as crashing head on with traffic travelling in the opposite direction at speeds varying from 30 to 40 miles per hour. This bridge has the further innovation of roller bearings instead of phosphor-bronze bushed bearings. These bearings also have spherical ball seats so that they adjust themselves for correct alignment in case of unequal deflection of the supporting structures. This feature reduces bearing friction to a minimum.[4]

4 "Civil Engineering," March, 1942, p. 140.

Some other new ideas are incorporated in the design of the South Canal Street bridge. The design calls for a double-leaf bridge with a four-lane roadway of the open grating type. There is a great economy in this type of floor for bascule bridges, because the saving in weight of the floor not only reduces stresses in the truss members, but effects a reduction in weight of the counterweight of two to three pounds for each pound saved in

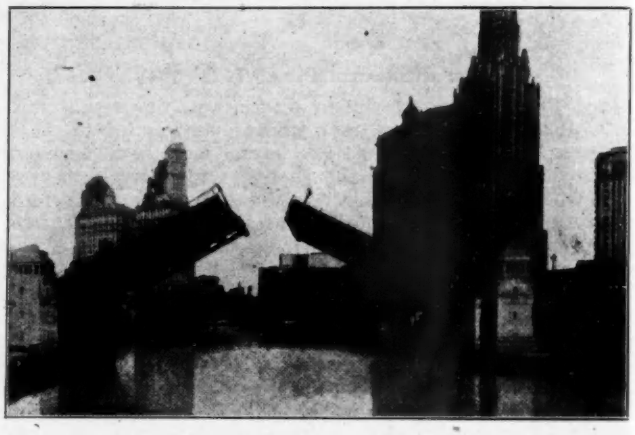


Fig. 18. North Wabash Avenue Bridge (1930).

the floor weight. Frequently, due to limited space for the tail end, this slight increase in weight can only be attained by the use of heavy unit-weight material which is usually more expensive than plain concrete that could be used otherwise; such a case was described previously in relation to the Adams Street bridge. Another innovation in this bridge is the use of hydraulic motors, instead of the usual electric motors, for driving the gear train. The prime power will be electricity as in the past but the electric motors will operate at constant speed driving an oil pump. By varying the displacement of oil by this pump (which displaced oil is used to drive oil motors at the gear trains), the speed of the bridge can be controlled more effectively than with electric

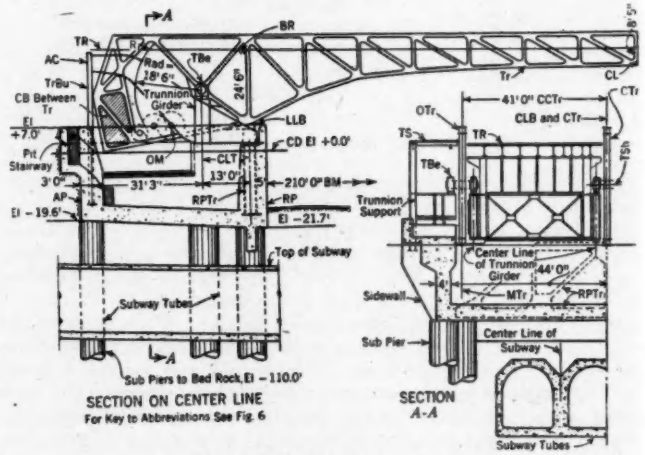


Fig. 19. North State Street Bridge.

motors which require considerable control equipment to handle the large currents involved. In this case, a simple push-button control is all that is needed to start and stop the constant-speed electric motors.

A total of 39 city-type bridges have been constructed in Chicago. Some of these were built by governmental bodies other than the city. The two on the Outer Drive at the mouth of the Chicago

Movable Bridges across Port Waterways—continued

River were built in 1937 by the Chicago Park District and were designed by a local firm of consulting engineers, but following, carefully, the city's practice on fundamental details. These bridges provide two four-lane roadways on the upper level, and the lower level provides for railroad tracks if future developments in this part of the city require them.[5]

As a side issue, not exactly within the province of this paper, is a note concerning the construction of the only movable bridge, not of the bascule type, constructed in Chicago in the past 25 years, at South Torrence Avenue over the Calumet River. A vertical lift type was used, at a location where the centre line of the river channel forms an angle of 50° with the centre line of the street. Here the U. S .War Department required a clear channel of 200-ft. with a 21-ft. headroom for the full channel. Hence a bascule bridge would have had to have a clear distance

TABLE 1.—DATA AND CHRONOLOGY, CHICAGO BASCULE BRIDGES
(Dimensions Are in Feet)

Year	Location (see Fig. 1)	Fig. No.	Bridge type[a]	Clear span	Between trunnions[b]	River channel	Bridge width	Trusses	
								No.	Type
1902	W. Cortland St. (Clybourn Place)	5	SD/DL	115.0	128.0	92.0	60.0	3	Through
1903	E. 95th Street	..	SD/DL	140.0	154.0	120.0	60.0	3	Through
1903	W. Division St. (Canal)	6	SD/DL	135.0	149.0	90.0	60.0	3	Through
1904	W. Division St. (River)	7	SD/DL	155.67	172.67	100.0	60.0	3	Through
1904	N. Western Ave.	..	SD/DL	184.58	205.58	121.0	60.0	3	Through
1906	W. Archer Ave.	..	SD/SL	121.0	136.0	100.0	60.0	3	Through
1907	W. North Ave.	..	SD/DL	153.67	172.67	128.0	60.0	3	Through
1908	N. Halsted St. (Canal)	..	SD/DL	184.58	205.58	90.0	60.0	3	Through
1909	W. Kinzie St.	8	SD/SL	121.0	136.0	100.0	60.0	3	Through
1910	W. Erie St.	9	SD/DL	170.33	191.33	140.0	60.0	2	Pony
1913	W. Washington St.	..	SD/DL	170.58	197.33	150.0	57.25	2	Pony
1913	W. Grand Ave. (Indiana St.)	..	SD/DL	162.75	188.75	140.0	60.0	2	Pony
1914	E. 92d St.	10	SD/DL	200.42	228.0	190.0	60.0	2	Pony
1914	W. 35th St.	..	SD/SL	120.0	136.0	120.0	60.0	3	Through
1914	W. Chicago Ave.	11	SD/DL	161.25	188.75	150.0	60.0	2	Pony
1916	W. Lake St.	12	DD/DL	209.25	245.25	190.0	70.0	2	Double deck
1916	W. Webster Ave.	..	SD/DL	161.25	188.75	120.0	60.0	2	Pony
1916	W. Jackson Blvd.	..	SD/DL	173.5	202.27	147.0	64.0	2	Deck
1917	W. Belmont Ave.	..	SD/DL	161.25	188.75	75.0	60.0	2	Pony
1919	W. Monroe St.	..	SD/DL	165.5	192.79	164.0	60.0	2	Pony
1920	N. Franklin-Orleans St.	..	SD/DL	220.0	251.83	178.0	62.0	2	Pony
1920	N. Michigan Ave.	13	DD/DL	220.0	256.0	200.0	91.79	4	Double deck
1922	N. Wells St.	..	DD/DL	231.0	268.0	220.0	72.0	2	Double deck
1922	W. Madison St.	14	SD/DL	188.75	221.23	168.0	72.0	2	Rail height
1926	E. 100th St.	15	SD/DL	200.0	233.5	190.0	62.0	2	Pony
1926	W. Adams St.	16	SD/DL	173.0	199.0	151.0	64.0	2	Deck
1928	E. 106th St.	..	SD/DL	220.0	250.6	192.5	62.0	2	Pony
1928	N. LaSalle St.	..	SD/DL	210.0	242.0	200.0	86.0	2	Pony
1929	N. Clark St.	..	SD/DL	215.0	245.5	200.0	72.0	2	Pony
1929	W. Roosevelt Road (Twelfth St.)	..	SD/DL	170.0	204.0	170.0	90.0	2	Deck
1929	N. Damen Ave. (N. Robey St.)	..	SD/SL	120.0	162.23	120.0	62.0	2	Deck
1929	S. Damen Ave. (S. Robey St.)	..	SD/DL	212.0	243.83	140.0	66.0	2	Pony
1930	N. Wabash Ave.	18	SD/DL	232.0	269.0	193.0	90.0	2	Rail height
1932	W. Ogden Ave. (Canal)	..	SD/DL	158.0	191.0	132.0	90.0	2	Pony
1932	W. Ogden Ave. (River)	..	SD/DL	150.0	182.0	130.0	90.0	2	Pony
1933	S. Halsted St.	17	SD/DL	192.0	224.67	165.0	90.0	3	Pony
1937	Outer Drive (River)	..	DD/DL	220.0	264.0	220.0	108.0	4	Double deck
1937	Outer Drive (Canal)	..	DD/SL	70.0	96.5	70.0	108.0	4	Double deck
1938	S. Ashland Ave.	..	SD/DL	192.0	224.67	189.83	90.0	3	Pony
1942[c]	N. State St.	19	SD/DL	210.0	245.0	200.0	108.0	3	Rail height
1943[c]	S. Canal St.	..	SD/DL	224.0	254.5	171.0	68.0	2	Pony

[a] Key: SD = single deck; DD = double deck; DL = double leaf; and SL = single leaf. [b] Distance, center to center of trunnions. [c] Completion deferred until after the War.

between masonry of about 320-ft. At this bridge is in a commercial or maufacturing district, a skewed vertical lift bridge was not considered out of place and comparative estimates indicated the latter could be built for less than half the cost of a bascule.[6]

Conclusion

Figs. 5 to 19 indicate the development of the Chicago type bascule bridge from the Clybourn Place and Division Street bridges, down through the years to the latest structures. Table 1 gives statistical data, which, by comparison, show the development of this type of bridge better than meagre words. This type of bridge has proved highly satisfactory and has solved most of the problems existing previous to its development, as discussed in the historical part of this paper previous to 1900.

The navigation requirements can be met ideally by the proper selection of size and location of the channel, almost without limit. The requirements of street traffic are satisfied by the provision of a structure that can be operated reliably in a minimum of time and which provides a measure of protection to the traffic when open, not provided by a swing or lift bridge. Maintenance is kept at a low figure by avoiding pin-connected linkages except for the trunnions upon which the movable part rotates.

The extra cost (if any) of this type of bridge over swing or lift types has been justified by its far better appearance especially when placed in a congested section of the city. However, the development of this type of bridge has not yet reached a point of stagnation as demonstrated by the various bridges built during the so-called Refinement Period, beginning in 1923, and many more refinements can be expected in the years to come.

In the development of this bridge, exclusive credit cannot and should not be given to any one engineer. Most of the development was due to the efforts of the late John Ericson, city engineer, Thomas G. Pihlfeldt, engineer of bridges for more than 40 years, and Alexander von Babo, engineer of bridge design for more than 20 years.

5 "Engineering News-Record," April 15, 1937, p. 546; also April 22, 1937, p. 583.

6 "Ibid," November 17, 1938, p. 618.

Correspondence

To the Editor of "The Dock and Harbour Authority."

Dear Sir,

Hydraulic versus Electric Quay Cranes

Referring to Mr. Nicholson's letter of September 13th in your October issue, I entirely agree that the hydraulic crane is an excellent appliance, simple and reliable, and easy to work. I agree it can be made as fast as an electric crane and said so. I do not agree that normally it is of equal acceleration; it is certainly not so with rams for 25% overload. With larger rams and large and free flowing valves, pipes and mains its acceleration could be speeded up, but this would have to be paid for in excess power water consumption throughout its operating range, whereas the requisite overload capacity for high acceleration is inherent in the electric motors without loss of efficiency.

I agree that the tendency to damage in the event of fouling hatch coamings is greater with electric, but this is largely a matter of individual circumstances and, according to my experience, is not a frequent occurrence in any case.

I do not agree that electric maintenance costs are as 3 to 1 of hydraulic, nor that electric breakdowns are large in number. With modern cranes by good makers bought at reasonable prices (i.e. not on a cut-throat competitive basis), breakdowns should be very few. Of course, both breakdowns and maintenance costs depend on maintenance methods. Maintenance should be systematic on a properly rostered basis, designed to ensure to working parts examination, attention, and adjustment, at such periods as to keep them in condition and anticipate and obviate breakdowns. Under such conditions stand-by attendance is little required and can be incorporated with maintenance attendance.

It would be interesting to know what cranes Mr. Nicholson is comparing. Even early electrics gave very little trouble on their heavier working parts, such as the motors, gearing, etc., but detail parts, e.g. drum controller contacts, required a good deal of attention, and caused occasional interruptions calling for skilled adjustment. On modern cranes more liberal design of such parts and the use of contactor control as largely eliminated this. Hydraulic crane troubles, by familiarity on the part of the operating staff as Mr. Nicholson says, can be largely attended to by them, and there is no question but that the hydraulic crane has fewer working parts. On the other hand, there is nothing pertaining to the electric crane subject to the frost and other troubles of the hydraulic crane and its mains.

Besides the outstanding factor of relatively much lower power costs, there are other points as set out in the article which need not be reiterated, favouring the adoption of electricity in preference to hydraulic power, which I note Mr. Nicholson, in any case, advocates for pumping his pressure water.

It is significant that where electric cranes have once been installed, their use in preference to reversion to hydraulic plant has been extended, and this would hardly be the case were Mr. Nicholson's experience and views general.

Yours faithfully,

J. DALZIEL.

Chorley Wood, Rickmansworth.

18th October, 1943.

The Economic Future of Canals and Inland Waterways*

By W. FRASER. M.A., Secretary and Traffic Manager, Trent Navigation Company.

NOTE.—The discussion of this subject will inevitably involve the consideration of other forms of transport in existence.

General Review

THERE are 58 separate canals in England of which 35 belong to the main line railway companies, and 23 are owned by independent undertakings. The mileage of all canals amounts to 2,566. The capital expenditure upon the independent canal undertakings amounts to over £20,000,000 and covers 1,500 miles of waterways open for traffic, and the railway-owned canals represent a capital expenditure of £8,000,000 for 614 miles of canals open for traffic. In 1938 the results of operation of the railway-owned canals showed a net loss of £61,000. In the case of the independent undertakings the average rate of return from all sources upon capital expenditure was less than 2 per cent., of which less than a third came from traffic operation. It is apparent that canal capital must be much beyond the limit which can be accurately described as economic.

Mr. W. FRASER, M.A.

Inland waterway transport differs from railway transport in that the owners of the waterway or track do not have a monopoly of carriage. On the contrary, with three exceptions, none of the proprietors of the waterways engage directly in the business of carriers. The statutory proprietors are normally responsible for the provision and maintenance of navigation works and a navigable channel. In return for these services they receive a toll which is charged on each ton of traffic passing over the navigation. The maximum toll chargeable is fixed by statute, but there is no limitation on the amount by which the statutory maximum may be reduced. The provisions of the General Railway and Canal Traffic Acts with regard to undue preference, obligation to provide reasonable facilities (including through traffic facilities), through rates and charges and publication, place obligations on canal companies similar to to those applicable to railway companies.

It is perhaps curious that whereas Parliament saw fit to regulate the promotion of inland navigations and to fix, among other things, maximum tolls, yet in very few cases has any statutory minimum standard of efficiency of navigation been created. Thus certain navigations, such as the Derby Canal, have been neglected and allowed to fall into disuse and are of no value to the national transportation system, but their proprietors are enjoying substantial dividends arising from the sale of water and the fortuitous appreciation in value of industrial sites orginally secured for navigation purposes.

Again, certain waterways, and this applies particularly to railway-owned canals, are maintained to about the same standard of efficiency as obtained in the pre-railway era, and continue to be governed by archaic restricting bye-laws which prohibit development of carrying services.

On the other hand, there are also a number of canals, such as the Aire and Calder Navigation, which have shown commendable initiative and foresight and, with sound commercial prudence, have continually improved their navigations, modified tolls and conditions to meet competition and can claim to be essential links in the transportation system of the country.

With the development of road transport, certain inland waterways have become redundant and should be abandoned. They have no economic future and their usefulness has been outlived.

Divided Ownership

Even in the case of the progressive undertakings it cannot be said that they are altogether economically sound. The divided ownership of through routes with varying depths of draught, width, briggage, size of locks and standards of maintenance results in inefficiency of working. This causes increased tolls to be levied and restricts through navigation on a route to the maximum size and tonnage of craft which can navigate the narrowest or worst maintained section. The least profitable type of vessel has to be operated over the whole route or alternatively costly transhipments are necessitated because of the use of the best type of vessel over that section of the through route which is widest and best maintained.

Perhaps the inland waterway route from the Humber to Birmingham affords a conspicuous instance of divided ownership and control. The distance between the Port of Hull and the centre of Birmingham is 162 miles and is divided into nine different sections under the control of six different navigation authorities. The financial and commercial interests of these different ownerships are not always harmonious. Through tolls are so general or so low as would be expected with a unified ownership. Improvements sometimes urgently required are delayed or abandoned because the owners of one section of the waterway will not in general improve their own section unless they are sure that the owners of the remaining sections will improve their lengths to the same standard. Nor will the owners of one waterway spend money readily on the improvement of their length of the route if most of the resulting benefit is likely to accrue to the owners of other sections.

This position compares with that on the inland waterway route from the Thames to Birmingham, where eleven independent navigations have been consolidated into the Grand Union Canal Company, five of them having been absorbed into the main line from London to Birmingham.

It cannot be in accordance with the economic principle for small undertakings to continue to operate as separate entities while they constitute essential links in the inland waterway transportation system of the country. By amalgamating these units nationally or in regional groups management and overhead costs will be reduced; the existing drawbacks will be avoided of plant lying idle or men working on less urgent work on their own undertaking when they should, by pre-arrangement, be used more effectively elsewhere; duplication of machinery and stores will be eliminated by the concentration into central depots of a large part of the maintenance plant existing in the several dockyards and depots of the various units. Grouping will enable obsolete and inefficient

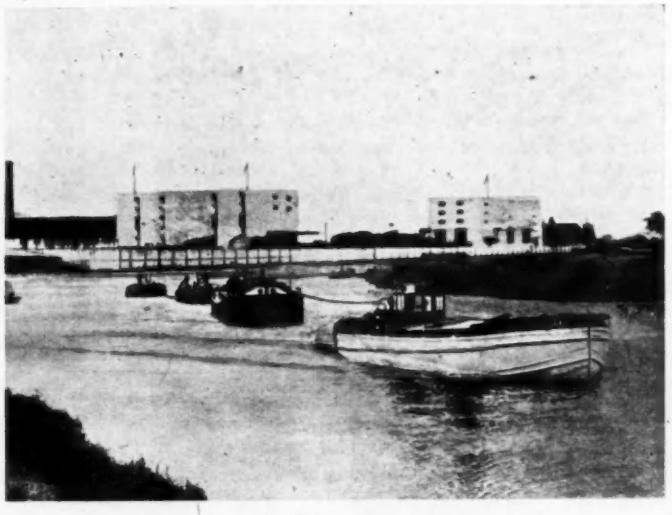
*Paper read before the Mansion House Association on Transport.

Economic Future of Canals and Inland Waterways—continued

plant to be scrapped and will also permit the concentration at any point of a large force of men who are experienced in works of navigation maintenance, and many of whom are highly skilled, so as to complete a repair job more quickly than can be done at the present time when the work is undertaken by the men of one of the existing undertakings alone. This is of particular moment to the trader who demands a reliable and efficient service for the movement of his goods.

The Chamberlain Report

As the ownership of a canal is a natural monopoly with a high capital value and requires a policy of development which may not be dependent on financial considerations alone it lends itself to Public Control. The Second Interim Report of the Committee on Inland Waterways, presided over by Mr. Neville Chamberlain, in 1921, sets out clearly the reasons why individual private canal companies trading for profit are unable to provide facilities for more efficient navigation. The report also affirms that a mere amalgamation of the existing owners, if desirable, will not suffice to enable the waterways to play a very important part in the transport of the country unless means are found whereby finance is provided for their improvement and development.



Barge Traffic on River Trent.

The Report contemplates the amalgamation of waterways into a series of groups owned and administered by Public Trusts, limited as to dividends and financed wholly or partly by the State and the Local Authorities concerned. The Trusts would take the form of statutory bodies composed of representatives of the Ministry of Transport, the Local Authorities of the area covered by the group, users of the waterway, Chambers of Commerce and the stockholders. The stockholders would comprise the original owners of the various waterways in the group who would receive Trust Stock in return for their interest.

So long ago as 1872, a Joint Select Committee recommended that the utmost facilities should be given for the amalgamation of adjoining inland navigations with one another. The Royal Commission on Canals and Inland Navigations of 1907-9 recommended the consolidation into four groups of those waterways, known collectively as the Cross, which form the principal routes from the Birmingham area to the four ports of London, Hull, Liverpool and the Severn. The Royal Commission on Transport of 1930 recommended that, failing voluntary amalgamation within a short period, the Minister of Transport should take steps to set up Public Trusts which would acquire such canals as it would be in the national interest to preserve and improve. Except in the case of the route from London to Birmingham which is now vested in the Grand Union Canal Company, the recommendations of the Committees have not been followed and unfortunately they are not likely to be achieved voluntarily within the industry.

The recent history of the Grand Union Canal shows the accuracy of the prediction of the Neville Chamberlain Committee of 1921 in respect of the inadequacy of mere amalgamations, and the need for the creation of Trusts. The Grand Union is 255 miles in length and is the longest canal in the country under the control of any single undertaking. With some Government assistance, and as part of unemployment relief work, the Grand Union Company spent £1,000,000 on rebuilding locks, but failed to secure sufficient money to complete a dredging programme, the result being that the benefits likely to accrue from the fulfilment of the complete programme of improvements were stultified.

Twice within the last quarter-of-a-century the State has recognised the essential importance of the inland waterway system to its own requirements and has proclaimed the vital necessity of amalgamation under public control; only in that way could the most efficient use of the waterways be secured. When its own needs had been satisfied in 1919 the State promptly proceeded to hand the canals back to their several owners twelve months before their chief competitors, the railways, were released from control. But instead of the railways emerging from control in their same condition as in 1914, which was similar in many respects to that of the canals in 1939, the consolidation into four main line companies was effected, much " dead-wood " capital was written off and a strong, unified industry, with a common front, was in being. The amalgamation was a long step towards an effort to create an economic position in the railway world and without such an arrangement their position in the feverish, hectic rush of competition, brought about by the development of the road transport industry in the succeeding twenty years, might have become intolerable. The present condition of the inland waterways requires more drastic treatment, but if traders are to have vouchsafed to them this form of internal transport, the Ministry of War Transport must act before the present period of State control of them ends.

Accordingly, it is suggested that the Government should effect the consolidation of certain waterways into seven groups, as set out broadly in paragraph 7 of the Chamberlain Report, each being under the control of a Public Trust. Each of these proposed groups centres round an important traffic route and is believed to be constituted on the lines of informed engineering opinion and to have regard to geographical and hydraulic considerations.

Certain waterways would be excluded from the initial grouping because they are either efficiently managed independently of the rest of the canal system and do not form parts of important commercial through routes (such as the Lee Navigation, the Thames Conservancy and the River Nene) or they are canals, the commercial prospects of which would require further investigation before their inclusion would be warranted (such as the Derby Canal, the Kennet and Avon Canal and the Lancaster Canal).

Proposed Lease of Waterways to Public Trusts

It is suggested that on an appointed day the Government would lease the waterways concerned at a nominal rent and delegate their administration to the Public Trusts. Each lease would have to contain the condition that the Government will purchase each undertaking at a price to be agreed and the general formula covering the method of working out the agreement would have to be included in the lease. It would seem that the purchase price can be ascertained readily by capitalising the compensation being paid by the Government under the Canal Control Order, 1942, although adjustments might be necessary in some cases to leave out of account surplus property or free investments of the undertaking to be absorbed. The purchase would act retrospectively as from the date of the commencement of the lease and rent would have to be paid for the period between the appointed day for the beginning of the lease and the date of completion of purchase. In taking power to lease the waterways concerned the Government would also take power to lease any other waterways at their discretion at a later date and after enquiry.

In considering the economic future of the inland waterway industry it is pertinent that consideration should be given to the minimum economic size of an inland waterway vessel operating on long distance voyages with special reference to the deadweight tonnage capacity in relation to the size of the crew. What is the

Economic Future of Canals and Inland Waterways—continued

smallest vessel which will provide an economic wage for the crew and compete with other forms of transport?

Prior to the construction of narrow canals, horse-drawn road vehicles were the sole means of inland transport. On the roads of those days a horse might move a ton 20 miles in a day so that the driver had 20 ton-miles to his credit. On a canal, however, the horse moved 25 tons over a distance of 30 miles, daily so that the canal boat had to its credit 750 ton-miles, and if the crew consisted of two men the ton mileage per man per day was about 16 times as much as that in the case of the horse-drawn vehicle. Clearly the canal appeared an attractive prospect, and was, in fact, prosperous, at any rate until the advent of railways.

The development of the internal combustion engine has completely altered this position—road transport has come into its own again and is a serious competitor to rails as well as to canals.

A 15-ton motor lorry operated by a driver and a mate, each earning a reasonable wage, performs on the average 110,000-ton miles per annum per man.

A minimum train of 100-ton boats—three dumb boats, manned by a crew of six, and one power vessel with a crew of three, all members receiving a reasonable wage—performs on the average 142,000-ton miles per annum per man which is 30 per cent. more than that performed in the case of a motor vehicle.

With narrow canal boats, however, the position is different. A single narrow boat manned by a crew of two carrying up to 30 tons of cargo and operating on a canal with locks capable of holding only one vessel at a locking cannot possibly compete with road transport vehicles.

A pair of narrow boats, one towing another, requires a crew of two and the distance covered in a day is 35 miles. The ton-mileage per member of the crew is about 86,000 per annum, which is only 60 per cent. of the output of the 100-ton vessels. It is apparent therefore that economically a pair of narrow canal boats can scarcely compete with the large carrying type of vessel nor with modern road transport vehicles.

Investigation shows that the smallest boat which will provide an economic wage for a crew of two men and can compete with road transport should have a deadweight capacity of 80 tons. Accordingly, if the waterways are to play an essential part in the internal transportation system of the country, they should be improved to accommodate vessels with a deadweight capacity of not less than 80 tons and this should be the recognised minimum standard for boats able to pass over any of the future main line canals. This does not mean that any obstacle should be put in the way of the improvement and maintenance of those waterways which are or can be developed to enable boats of a higher capacity to pass. It does mean, however, that a statutory obligation should be placed on the Public Trusts to improve their tracks to this minimum standard and to continue to effect such maintenance as is required to prevent any reduction from this standard of efficiency.

(To be continued)

Pacific Coast Association of Port Authorities

Address by the Chairman of the Canadian National Harbours Board

The 30th Annual Conference of the Pacific Coast Association of Port Authorities was held in Vancouver, British Columbia, on July 29th and 30th last. The President, Mr. K. K. Reid, Chairman of New Westminster Harbour was in the chair.

Three subjects discussed were "The disposal after the war of terminal properties taken over by the Federal Government for war purposes"; "The situation confronting ports, due to the rapid elimination of forests" and "Relations between privately-owned and publicly-owned port facilities."

In the evening there was a dinner, at which Mr. R. K. Smith, K.C., Chairman of the National Harbours Board of Canada, was the chief speaker. Mr. Smith's speech, as reported in the *Shipping Register* for August last, was as follows:—

"Adjustment from war to peace-time movements of cargo and people will have to be made, and arrangements for capital expenditure and port development must be carried out.

"Port Authority must also take into consideration that its business now includes air transport and can no longer be confined to land and water movement."

Mr. Smith pictured a very great increase in exports immediately after the war, and said he did not feel anxiety regarding the sufficiency of ships' bottoms to handle the business.

He pointed out that while Canada built no ships for 20 years preceding the war, it launched, in May and June of this year, a total of 33 cargo vessels. There were in Canadian yards, or delivered, 300 ships, 90 per cent of them 10,000-ton freighters. In the United States, in the first six months of this year, were launched more than 8,000,000 gross tons of shipping, slightly more than the total delivery of American yards in the whole of 1942. Canadian yards had built 90 ships for United States Government, two to British Government and the balance to Canadian order.

"War-time policy," he continued, "is to provide the longest rail hauls and the shortest water hauls—exactly contrary to the policies of transportation during peace-time. Thus, immediately war ends, a reversal of this policy will take place. The ports must be ready for it.

"It will take the highest technical talents and the supreme capacity of many experts to unwind the unnatural, uneconomic war-time practices and developments, in order to establish ourselves on a peace-time basis."

Congestion of services in ports must be expected for some time following cessation of hostilities. Export of foodstuffs, materials and supplies to rehabilitate invaded countries and feed the starving populations will be a natural development.

"We can expect," he said, "an extension of present facilities to meet the increased export trade; we can also expect a possible modification of immigration policies and an influx of selected immigrants.

"Seaports of the present day are highly organised to handle rail, water and road-borne traffic.

"It will, therefore, be obvious that the great airports of the world will be an integral part of existing great seaports. The handling of transshipment between air, rail, road and water, air-to-sea and sea-to-air must be provided for.

"Post-war reconstruction will be undertaken with these objects in view, as well as providing employment for ex-service men, and for industrial workers thrown out of work because of the change-over.

"War has interrupted the normal expansion of capital works, and in some cases has interrupted upkeep. Facilities have suffered from deferred maintenance. All will have to be brought back to proper working conditions by expenditure of large quantity of labour and material."

Mr. Smith mentioned the possibility of a post-war Canadian fleet of more than 200 large seagoing ships; he suggested that Canadian shipyards would continue production, building faster and finer vessels.

The speaker also paid tribute to the officers and men of the merchant navy. "The United States and Canada," he concluded, "partly because of common heritage of laws, language, tradition and institutions, will together wield a mighty influence on post-war construction."

Business Announcement.

The Brush Electrical Engineering Company Limited and Metropolitan-Vickers Electrical Company Limited announce that they have fused their interests in the Battery Electric Vehicle Industry.

Bluff Harbour Board, New Zealand

Extracts from Annual Report

The Report on the operations of the Board for the year ending 30th September, 1942 shows that the total cash receipts amounted to £38,535 as against £37,685 for 1941. Expenditure amounted to £38,563 as against £42,981.

Dredging.

The Dredger "Murihku" underwent annual overhaul in October 1941. The Board has, on several occasions, gone into the question of continuous dredging and it is considered vitally necessary to keep the dredger in commission. Practically only maintenance work is being undertaken during the war.

During the year the Board considered the question of a scheme for dredging South Island ports, to be carried out by a Dredging Board elected by the Boards throughout the South Island, the origin of the scheme being a report on the matter prepared by Mr. D. E. S. Mason, the Board's Engineer, and Mr. McG. Wilkie, Engineer to the Otago Harbour Board. The principle of the scheme has been approved by all the South Island Boards, but, by common consent, it has been held over for consideration after the war.

Membership Changes.

The death is recorded of Mr. A. H. Aitken who had served on the Board for a period of over 25 years, being Chairman for a term of three years from 1927 to 1930.

The oldest member of the Board, Sir Robert Anderson, K.B., C.M.G., also died just after the close of the year under review. He had served for an unbroken period of 41 years.

The vacancy on the Board caused by the death of Mr. Aitken has been filled by the appointment of Mr. J. W. Ingram; and the Hon. T. F. Doyle, M.L.C., has been appointed Government Representative in the place of the late Sir Robert Anderson.

Particulars of shipping and trade and a number of other matters have been withheld in consequence of Government instructions prohibiting the publication of such information.

Post-War Planning for Clyde Ports

An important proposal for the co-ordination of the post-war planning schemes of the principal Clyde ports was recently considered at a meeting in Glasgow at the office of the Regional Port Director for Scotland. In a statement issued after the meeting, Mr. T. Macpherson, the Regional Port Director, said that the meeting was attended by representatives of the Clyde Navigation Trust, Greenock Harbour Trust and the Ardrossan Harbour Company.

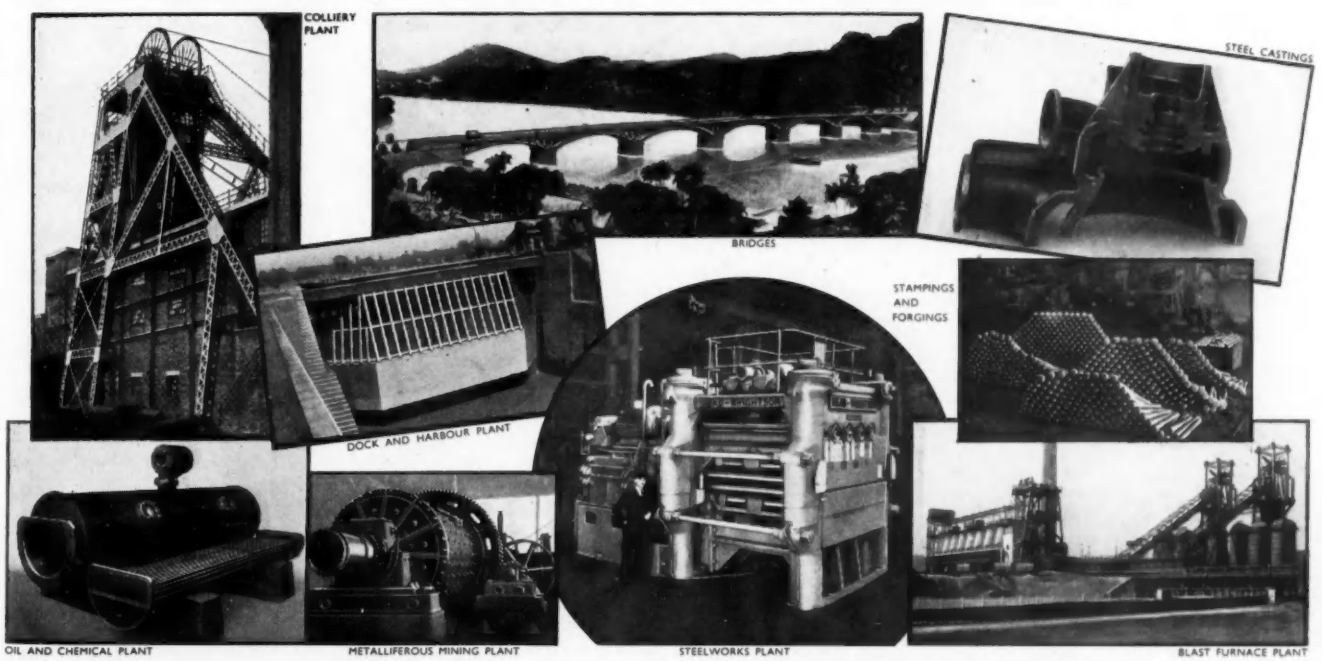
"Consideration was given to a proposal by the Ministry of War Transport that the various post-war development schemes of the harbours should be considered as a whole, rather than as individual schemes. The arrangements by which a joint consultation could take place were discussed, and the willingness of the port authorities to collaborate was sought. The matter was deferred pending consideration by the three constituent bodies."

It is understood that each of the three port authorities has already submitted its proposals for post-war development to the Ministry of War Transport, covering immediate work on deferred maintenance and a long-term development programme. It is felt that collaboration among the authorities is desirable so that, without stultifying individual enterprise, development may be on economic lines and that something greater may be achieved collectively than would be possible by individual action.

Praise for the work of the Clyde dockers, stevedores and harbour officials was expressed by the Regional Port Director speaking in Glasgow. He said that the average tonnage discharged per ship, per working day, during August, was the highest for the Clyde this year, and greater than during the same month last year.

"The figures" he said, "present the Clyde ports in a favourable light compared with any other port in Great Britain.

WANTED.—November, 1942, issue of "The Dock and Harbour Authority," Box No. 65. 19, Harcourt Street, W.1.



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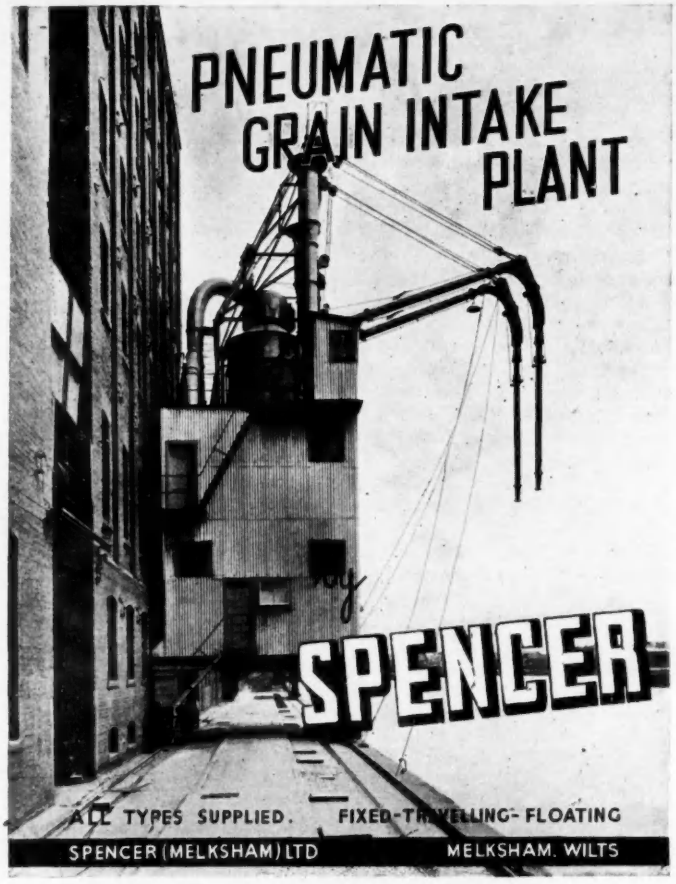

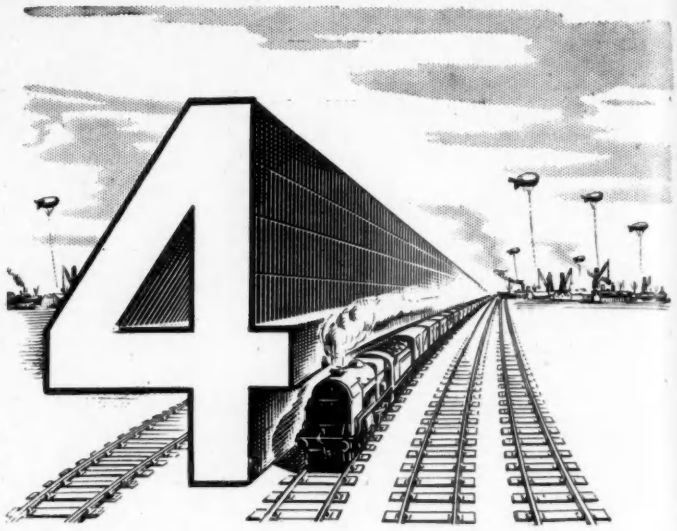

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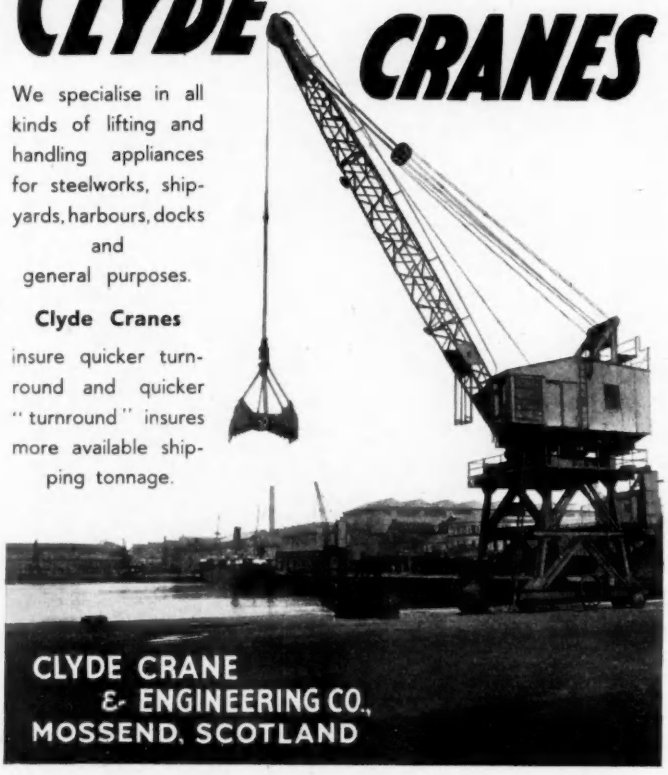
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